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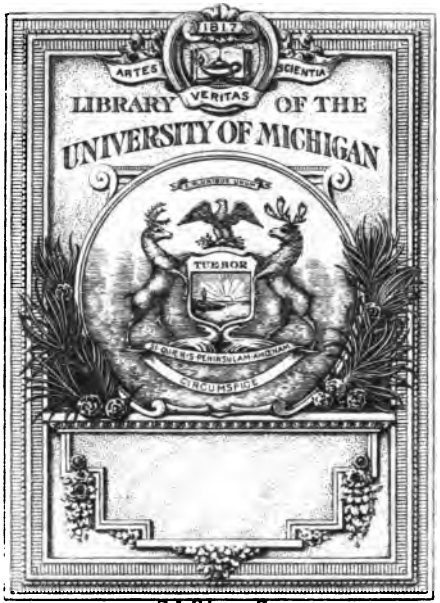

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MOSSES

WITH A HAND-LENS

A NON-TECHNICAL HANDBOOK OF THE MORE COMMON AND MORE EASILY RECOGNIZED MOSSES OF THE NORTH-EASTERN UNITED STATES

BY

A. J. GROUT, PH. D.

BOYS' HIGH SCHOOL, BROOKLYN, N. Y.

H. S. Jewett, M. D. Dayton, Ohio Oct. 1909

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REVISED, ENLARGED AND INCLUDING THE HEPATICS

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PREFACE TO THE SECOND EDITION.

THE preparation of the First Edition was an experiment, as there was some doubt as to the demand for such a book and considerable uncertainty as to how many people would be able to use it successfully. The sales of the First Edition have proved conclusively the demand for a book of this kind, and it has also been proved that the hand-lens can be successfully used to determine a much larger number of mosses than was included in the First Edition. This is shown by the readiness with which persons of no special scientific training have identified the common mosses by its use.

By the use of slides prepared as for the compound microscope, and the very best lenses such as are advertised in the last pages of this book, many characters which were little or not at all used in the First Edition can be utilized in determining difficult species. Such characters are the gross structure of the peristome, the characters of the costa, and the margins of the leaves, position of the reproductive organs, and in many cases the general outline of the cells.

The hand-lens can never equal the compound microscope for making out these finer details of structure, but the compound microscope is beyond the reach of many who would gladly study the mosses if it can be done with a hand-lens. No characters have been utilized which the author has not been able to make out with his lens, but it may easily be true that the beginner may not be able to see as much at first. The author believes that the limit of utility of the hand-lens has been reached in this edition, so far as the mosses are concerned at least. The section on the Hepatics is less complete owing to the limitations of the author.

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The arrangement of the families has been slightly changed and the glossary has been greatly changed; all the terms describing characters discernible by the compound microscope alone have been omitted and a number of common botanical terms have been added for the convenience of amateurs.

My thanks are due Miss Thayer for her careful work in preparing the illustrations not otherwise acknowledged, and to Dr. Evans for suggestions and the use of some of his illustrations of Hepatics. Many of the additional illustrations are from the Bryologia Europea and a smaller number from Sullivant's Icones and Gray's Manual. Miss Alice Crockett has read all proofs. Mrs. Annie Morrill Smith has greatly assisted by the loan of books, specimens, and illustrations.

A. J. GROUT,
Boys' High School,
Brooklyn, N. Y.

March, 1905.

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PREFACE TO THE FIRST EDITION.

MOSSES are individually so small and inconspicuous that the effect which they have as a mass in creating and enhancing the beauty of natural scenery is often overlooked. Yet if one recalls the desolate and uninviting appearance of a wood in which the mosses have been destroyed by fire, or observes carefully the part which mosses play in completing the attractions of mountain scenery, he will feel like saying a hearty amen to Ruskin's enthusiastic words in the closing paragraphs of his essay on "Leaves Motionless."

The freshness which a summer shower brings to the landscape is largely due to the unfolding of the mosses on tree and fence and boulder from patches of lifeless brown into soft cushions of living green.

Many lovers of nature have observed the beauty of mosses and have collected them for their beauty alone. Many more would have collected and studied them had not the difficulties been so numerous and hard to overcome. Until very recently there has been no literature in the English language that was suited to the needs of the beginner. Owing to the small size of most mosses, the characters which separate species and even genera are so largely microscopic that a compound microscope has been considered an absolute necessity for their study.

Many years of study of mosses in the field and in herbaria have convinced the author that any person of average intelligence can easily learn to recognize seventy-five to one hundred common mosses with the aid of an ordinary hand-lens of ten to fifteen diameters magnifying power.

The purpose of this work is to give, by drawings and descriptions, the information necessary to enable any one interested to become acquainted with the more common mosses with the least possible outlay of time, patience, and money. The drawings were made without the aid of the compound microscope in order that nothing might be represented that is not readily distinguished with the simple microscope.

Finally it must be borne in mind by the student that the present work is limited and incomplete in its treatment, and is but a stepping stone to the larger and more complete works, and to the broader and fuller study of bryology.

A. J. GROUT,
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Brooklyn, N. Y.

August, 1900.

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KEY TO THE FAMILIES OF MOSSES.

In using these keys the student is advised to turn to the illustrations in the main part of the book, to explain any of the characters used in the key that are not otherwise perfectly clear. A free use of the glossary is also suggested.

		PAGE
1.	Plants whitish or light gray, scarcely appearing green. . . . . 2.	
	Plants green, yellow-green, or dark green to almost black. . . . . 3.	
2.	Plants of bogs; capsules nearly globular, ovoid when dry and empty, without peristome . . . . . *Sphagnaceae.*	11
	Plants of moist shady places, growing in dense tufts or cushions; capsules elongated, with a peristome. . . . . *Leucobryum* in *Dicranaceae.*	50
3.	Leaves in two rows, with edges apparently towards the stem. . . . . 4.*	
	Leaves in more than two rows, or if apparently two ranked, the edges of the leaves are not toward the stem. . . . . 5.	
4.	Leaves apparently split on the inner edge and sheathing each other and the stem, costate; peristome present. . . . . *Fissidentaceae.*	30
	Leaves ecostate, not split at base, but forming a continuous wing-margin along the stem in the sterile plants; peristome lacking. . . . . *Schistostegaceae.*	86
5.	Acrocarpous. . . . . 6.	
	Pleurocarpous. . . . . 20.	
6.	Plants black or blackish green; leaves opaque or nearly so because of the very thick cell-walls; growing on trees or rocks. . . . . 7.	
	Plants green to light yellow-green, or, if blackish, growing on soil. . . . . 9.	

*Some hepatics will be sought here.

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7. Capsule dehiscing by four valves, as in the Hepaticæ, almost exclusively alpine or sub-alpine. . . . . *Andreaeaceae.* 15

Capsule dehiscing by an operculum; peristome of 16 jointed teeth. . . . . 8.

8. Peristome single (very rarely lacking), with teeth not united in pairs, but usually perforate or bifid, richly colored and rarely reflexed when dry. Plants often hoary with colorless leaf apices, nearly all growing on rocks. . . . . *Grimmiaceae.* 51

Peristome double (with one or two exceptions), teeth often united in pairs, rarely perforate, usually reflexed when dry, inner peristome of very narrow linear erect segments. Plants very rarely hoary, mostly tree-growing. . . . . *Orthotrichaceae.* 78

9. Peristome of four large distinct unjointed teeth . . . . . *Georgiaceae.* 17

Peristome having an inner plaited whitish cone; outer peristome of shorter teeth often present. Odd plants best recognized by a reference to the illustrations. . . . . *Buxbaumiaceae.* 28

Peristome lacking, or of more than four teeth. . . . 10.

10. Peristome of 32 to 64 short teeth, joined at the tips to a membrane which nearly closes the mouth of the capsule; calyptra densely hairy with long whitish hairs (except *Catharinea*); leaves with numerous vertical lamellae on the upper surface of the costa. Plants large and very dark colored, growing on soil. . . . . *Polytrichaceae.* 18

Peristome when present consisting of 16 to 32 plainly articulate teeth, frequently lacking; mouth of capsule not closed by a membrane. . 11.

11. Capsules cleistocarpous. . . . *Bruchia* in *Dicranaceae.* 36

Capsules cleistocarpous. . . *Astomum* in *Tortulaceae.* 37

Capsules gymnostomous; leaf-cells small, dense . . . . . *Pottia* and *Weisia in Tortulaceae.* 91, 64

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Capsules gymnostomous, leaf-cells large, clear .....*Physcomitrium* in *Funariaceae*. 90
Capsules peristomate.....13
13. Capsules with a large swollen hypophysis, which is usually larger and more conspicuous than the spore-bearing part; leaves not papillose; growing on decaying animal matter.*Splachnaceae*. 88
Capsules without hypophysis (some with slender necks).....14.
14. Capsules strongly plicate when dry and empty, often strongly unsymmetric.....15.
Capsules not plicate or striate when dry or only very slightly so.....18.
15. Peristome single.....*Dicranaceae*. 34
Peristome double.....16.
16. Capsules subglobose; inner peristome without cilia, or cilia very small.....*Bartramiaceae*. 94
Capsules elongated, cilia well developed.....17.
17. Capsules strongly unsymmetric with the mouth nearly on one side; segments opposite the teeth.....*Funariaceae*. 89
Capsules only slightly unsymmetric; segments alternating with the teeth.....*Aulacomniaceae*. 92
18. Capsules subpendent to pendent; peristome double.....*Bryaceae*. 96
Capsules often unsymmetric or inclined, but never subpendent; peristome single, teeth usually forked or twisted or both.....19.
19. Leaves nearly always crisped when dry; peristome in most cases of filiform twisted teeth. .....*Tortulaceae*. 63
Leaves rarely crisped; peristome of 16 reddish forked teeth which are never twisted..... .....*Dicranaceae*. 34
20. Aquatic, long and floating, with leaves straight; or plants shorter with falcate-secund leaves and often only partially submerged; capsules immersed or emergent, never exserted.... .....*Fontinalaceae*. 146

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Terrestrial (or a few aquatic), seldom slender or floating, with capsules exserted on long setæ..21.

21. Tree growing species with the capsules partially immersed in the perichaetial leaves or at most barely exserted.....23.

Not growing on trees, or if so with capsules long exserted.....22.

22. Leaves subopaque, dense, usually small; leaf-cells short.....*Leskeaceae.* 108

Leaves nearly transparent, leaf-cells in most cases elongated; peristome with cilia except in species with erect capsules.....*Hypnaceae.* 114

23. Stems and branches flattened; leaves appearing two-ranked.....*Neckeraceae.* 143

Stems and branches nearly terete; leaves not appearing two-ranked.....*Leucodon.* 141

H. S. JEWETT, M. D.
DAYTON, OHIO.

KEY TO GENERA.

Plants with luminous protonema, growing exclusively in caves and dark holes..*Schistostega.* 86

Plants gray to gray-green, growing in bogs and swamps.....*Sphagnum.* 11

Plants not gray (except *Leucobryum*) growing in various situations..... 1.

1. Acrocarpous.....A.
2. Pleurocarpous.....B.

A.

1. Capsules square in cross-section; calyptra densely hairy.....*Polytrichum.* 19

Capsules round in cross section; calyptra extinguisher-like, completely covering the capsule.....*Encalypta.* 76

Capsules round in cross-section; calyptra various. 2.

2. Blackish to brownish-green; growing on the bark of living trees..... 3.

Blackish to brownish-green, growing on rocks...34.

Green, growing in various situations but not on trees..... 5.

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		PAGE
3.	Capsule long-exserted, not wrinkled when dry... 4.	
	Capsule short-exserted, strongly wrinkled when dry; leaves crisped when dry.....*Ulota.*	79
	Capsules immersed or partially exserted, strongly wrinkled (except *O. speciosum*) when dry; leaves not crisped.....*Orthotrichum.*	81
4.	Leaves crisped; capsule pear-shaped and puckered about the mouth when dry.*Ulota Ludwigii.*	79
	Leaves scarcely crisped, capsule ovoid, not puckered or folded.....*Drummondia.*	79
5.	Capsules immersed or partially exserted; seta not apparent..... 6.	
	Capsules exserted; seta evident..... 9.	
6.	Capsules green, without distinct lid; plants of sandy fields..... 7.	
	Capsules with lid and peristome; plants growing on shaded banks.....*Webera.*	29
7.	Leaves strongly crisped to spirally coiled when dry.....*Astomum.*	37
	Leaves not crisped when dry..... 8.	
8.	Capsules pear-shaped, partially exserted...*Bruchia.*	36
	Capsules nearly spherical, immersed and nearly hidden in the long slender leaves....*Pleuridium.*	35
9.	Capsules erect, urn-shaped, no peristome.....10.	
	Capsules erect, greatly swollen at base..*Splachnum.*	88
	Capsules strongly ventricose; mature plant without leaves.....*Buxbaumia.*	28
	Capsules erect, ovoid to cylindric, nearly or quite straight.....11.	
	Capsules arcuate, unsymmetric, usually cernuous..22.	
	Capsule symmetric, cernuous or pendent; ovoid, pyriform, or subglobose.....33.	
10.	Costa excurrent.....*Pottia.*	91
	Costa ending below apex of leaf....*Physcomitrium.*	90
11.	Plants growing on moist cliffs, usually on limestone; peristome lacking.....*Gymnostomum.*	63
	Plants growing on various substrata; peristome present.....12.	
12.	Growing on stones in running water..... .....*Fissidens Julianus.*	34

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Growing on rotten wood or occasionally on peaty banks....13.
Growing on soil....14.
Growing on rocks or cliffs....*Dicranum.* 45

13. Peristome of four teeth....*Georgia.* 17
Peristome of sixteen teeth....*Dicranum flagellare.* 49

14. Plants with hairy calyptra and appearance of the Hair-caps....*Pogonatum.* 23
Plants without hairy calyptra....15.

15. Peristome of 32 teeth attached to the columella as in the Hair-caps....*Catharinea.* 25
Peristome of 32 hairlike, strongly twisted teeth; leaves crisped when dry....16.
Peristome of 16 teeth often divided and slender at apex but not hairlike or twisted....18.

16. Costa excurrent into a long white hair....*Tortula.* 72
Costa not excurrent or barely so....17.

17. Basal hyaline cells forming a V at the base of the leaves....*Tortella.* 70
Line of separation between hyaline and dense cells running nearly straight across the leaf ....*Barbula.* 67

18. Leaves tongue-shaped with long-excurrent costa as in Tortula....*Desmatodon plinthobius.* 74
Leaves short, closely imbricated; not tongue-shaped....*Ditrichum.* 37
Leaves long and slender, lanceolate; costa not excurrent or only shortly so....19.

19. Plants comparatively large; cells at basal angles of leaf abruptly enlarged and usually colored ....*Dicranum.* 45
Plants small; cells at basal angles of leaf not conspicuously enlarged or colored....20.

20. Plants rusty red; capsules more than twice as long as broad....*Didymodon rubellus.* 38
Plants green; capsule not more than twice as long as broad when moist....21.

21. Plants of sandy fields; leaves crisped when dry ....*Weisia viridula.* 67

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		PAGE
	Plants of moist banks; leaves not crisped..... ..... *Dicranella.*	41
22.	Plants greenish-white..... *Leucobryum.*	50
	Plants dark to light-green, not white.....23.	
23.	Leaves two-ranked; plants appearing flattened ..... *Fissidens.*	30
	Leaves not two-ranked, arising from all sides of the stem.....24.	
24.	Capsules smooth when dry.....25.	
	Capsules furrowed or wrinkled when dry.....28.	
25.	Capsules with a long slender neck.... *Trematodon.*	40
	Capsules with neck short or wanting.....26.	
26.	Plants in habit, peristome, and calyptra like the hair-caps..... *Pogonatum alpinum.*	25
	Calyptra not hairy; peristome of 16 teeth.....27.	
27.	Peristome double; dry capsules usually with a short neck (long in *Pohlia elongata*)..... ..... *Bryum* and *Pohlia.*	97
	Peristome single; capsules without neck, not strumose..... *Dicranum.*	45
	Peristome single; capsule plainly strumose.... ..... *Oncophorus.*	39
28.	Capsules subglobose when wet..... ..... *Philonotis* and *Bartramia.*	94
	Capsules elongated, often subcylindric.....29.	
29.	Growing on rotten wood..... *Dicranum.*	45
	Growing on soil or bases of trees.....30.	
30.	Growing in swamps or very wet places; peristome double..... *Aulacomnium palustre.*	92
	Growing in barren places, roadsides, paths, etc.; peristome various.....31.	
	Growing on soil, base of trees, or rocks; peristome single..... *Dicranella.*	41
	Growing most commonly at base of trees in woods; peristome double..... ..... *Aulacomnium heterostichum.*	94
31.	Capsules strongly curved, mouth at one side ..... *Funaria.*	89
	Capsules inclined, only slightly unsymmetric....32.	
32.	Seta yellow..... *Ditrichum pallidum.*	38

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Seta dark red-brown.....*Ceratodon.* 40

33. Leaves like those of *Dicranum longifolium* (see plate XI); seta arched in the middle; capsule without neck, pendent; peristome single .....*Dicranodontium longirostre.* 48

Leaves lanceolate; seta bent at the top; capsule long-necked .....*Leptobryum.* 102

Leaves lanceolate; capsule with short neck.... .....*Pohlia nutans.* 100

Leaves broadly ovate-lanceolate to ovate..... .....*Mnium* and *Bryum.* 103

34. Leaves without costa.....35.

Leaves costate.....36.

35. Leaves acute, white tipped; capsules entirely immersed, subglobose, opening by a lid..*Hedwigia.* 52

Leaves obtuse, without white tips; capsule splitting into 4 valves.....*Andreaea petrophila.* 15

36. Leaves crisped when dry, never white tipped.... .....*Ptychomitrium.* 53

Leaves not crisped, often white tipped..... .....*Grimmia* and *Rhacomitrium.* 55-59

Leaves not crisped; capsule splitting into four valves.....*Andreaea.* 15

B.

1. Growing on stones in or near running water.... 2.

Not growing in water..... 4.

Growing on the stems of partially submerged bushes.....*Dichelyma.* 146

2. Long and floating (*Fissidens Julianus* may be sought here).....*Fontinalis.* 146

Not long and floating..... 3.

3. Leaves without costa.....*Hypnum.* 115

Leaves costate.....
Rhynchostegium rusciforme, Brachythecium, Amblystegium, Hypnum ochraceum.

4. Leaves two-ranked or appearing so, flattened into one plane..... 5.

Leaves not lying in one plane..... 7.

5. Leaves without costa..... 6.

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Leaves costate; plants growing on cool moist rocks. . . . . *Homalia.* 144

6. Plants growing on trunks of trees. . . . . *Neckera.* 143
Plants growing on decayed wood. . . . . *Entodon* and *Raphidostegium.* 137, 127
Plants growing on soil or decayed wood. . . . . *Plagiothecium.* 136

7. Plants regularly once or twice pinnate, looking like miniature ferns. . . . . *Thuidium, Hypnum, Hylocomium proliferum.* 111, 115, 113
Plants not regularly pinnate. . . . . 8.

8. Capsules erect, straight. . . . . 9.
Capsules cernuous, curved. . . . . *Hypnum family.* 114

9. Growing on bark of trees. . . . . 10.
Growing on soil or decayed wood. . . . . 13.
Growing on stones or bark of trees. . . . . *Amblystegium adnatum.* 119

10. Growing only near the base of trees. . . . . 11.
Growing at various heights on tree trunks, seldom near the base. . . . . 12.

11. Light green; branches julaceous. . . . . *Thelia.* 110
Dark green; branches somewhat flattened or at least not julaceous. . . . . *Anomodon.* 109

12. Small; seta many times as long as the perichætial leaves. . . . . *Pylaisia.* 136
Larger; seta not more than twice as long as the perichætial leaves. . . . . *Leucodon.* 141

13. Plants treelike, growing on the ground in swamps. . . . . *Climacium.* 139
Plants growing in prostrate mats on soil or decayed wood. . . . . 14.

14. Leaves without costa. . . . . *Entodon.* 137
Leaves costate. . . . . *Anomodon rostratus* and *Brachythecium acuminatum.* 108, 139

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INTRODUCTION.

SO many different kinds of plants are called mosses that it may be well to clear the field by defining the true mosses as distinguished from the other plants popularly called mosses.

The sea-weeds or marine algæ are often known as sea mosses, but no true moss grows in salt water.

The moss which drapes the trees in swampy regions of the South is not a true moss, but a flowering plant bearing flowers and seeds like a rose or a geranium.

Lichens are frequently confused with mosses, but they never bear leaves and never are a bright green, but a grayish or brownish green, rarely black or bright colored. The majority of species consist of a flat thin body usually prostrate and closely applied to the substance upon which the plant grows. The "Reindeer Moss" is a lichen with shrubby hollow stems; the gray "moss" that hangs from the limbs of trees in Northern swamps is also a lichen.

The Hepaticæ, or liverworts, are most closely allied to the mosses and some species are difficult to distinguish from them. In general, however, the liverworts consist of a flat expanded body like a bright green lichen, or, if leafy, the leaves, which never have a costa, are arranged in two rows on opposite sides of the stem and often in the same plane, giving the plant a flattened appearance unlike the great majority of mosses. In fruit the capsule of the leafy forms opens by four valves instead of by a lid as in the mosses.

The terms used in describing mosses are fully defined and illustrated in the glossary, and the student should make himself familiar with the principal terms as early in his study of the mosses as practicable.

The beginner in the study of mosses should be content with the study of well developed fruiting specimens. Sterile specimens should never be attempted unless their genus is readily recognizable from previous experience, or some marked peculiarity renders recognition easy. Imperfect or non-fruiting mosses

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often prove an insoluble puzzle to the advanced student and would be nothing but a source of discouragement to the beginner. Many mosses of the more difficult genera like Hypnum and Bryum are not included in this book because they can not be recognized with any degree of certainty without the aid of the compound microscope. As some of these difficult species are common they will prove a source of annoyance to the beginner, and it is hoped will lead him to obtain, sooner or later, the necessary books and apparatus for a more extended study.

Almost any form of simple microscope will serve for the study of most of the mosses with this book, but to obtain the best results it should be of a construction suitable for carrying in the pocket into the field.

The hand-lens recommended for this book is of so short a focus that it can not readily be used for a dissecting lens, so that some form of dissecting microscope will prove very useful. If one can not afford a regular dissecting microscope costing from three to five dollars, a tripod costing less than one dollar will give good results. Place the object to be dissected on a piece of plain glass over white paper and stand the tripod on the glass.

For ordinary work a lens of from 15 to 20 diameters is needed, for the finer details a lens of 30 or more diameters is necessary. In studying very minute parts it will often be necessary to mount in water in the same manner as for the compound microscope. For the preparation of these slides the student should have half-a-dozen blank slides of glass, such as can be purchased of any dealer in optical goods, a small pair of fine flat-pointed forceps and two fine-pointed dissecting needles. A small scalpel is useful, but a good pocket knife will answer all purposes. Circles or squares of thin glass are useful, but two slides can be used with the object mounted in water between them. Mica can be used for covers or for slides and covers both.

In preparing these slides all specimens not fresh and moist should first be soaked out in hot water, the parts to be studied should then be carefully removed with the forceps and placed in a drop of water on one of the glass slides and covered with a cover circle or another slide. If one has a dissecting microscope with stand and mirror the slides can be studied in the usual manner, but almost as good results can be obtained by holding the slide up to a strong light and examining it thus as a transparent object.

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Two blank slides, two rubber bands, a pair of fine-pointed forceps, and a small vial of water carried in the pocket into the field will enable one to mount slides on the spot and will often save the trouble of carrying home useless material or, what is worse yet, leaving a good thing behind because it is not recognized. The rubber bands are to slip over the two slides and keep them in place when objects are mounted between them.

To use a hand-lens with the best results the object or slide should be held with the thumb and fore finger of the left hand, and the lens with the right hand. Then by resting the right hand on the left the lens can be focussed without difficulty. It is usually best to let the thumb of the right hand lie on that of the left. If the hands do not touch it is very difficult to keep them steady enough to keep a high power hand-lens in focus.

The only parts for the study of which the dissecting microscope is absolutely necessary are the antheridia and archegonia. These organs are readily found in acrocarpous mosses if not too badly decomposed by age, and after a little practice one will have little difficulty in distinguishing them with a high power lens. In the pleurocarpous mosses they are often difficult to find. The best plan is to soak the plant thoroughly and place it on a large piece of glass, over white paper, and dissect off all promising buds. These are to be dissected separately in a drop of clean water on a slide, but they are so small and so often shrunken or partially decomposed as to make their recognition difficult.

In counting peristome teeth it is well to remember that the teeth are always in multiples of four, 4, 8, 16, 32, or 64, so that if a number more than one of these numbers is found one may know that the entire number is not less than the next higher.

Every one intending to study mosses will find a collection of dried specimens invaluable, and a collection is more easily made and cared for than with any other group of plants. The only reason for pressing specimens of mosses is that they may be stored satisfactorily in the herbarium. Each species has a distinctive look when naturally dried *in situ*, and the pressure should not be great enough to obliterate this. Note the difference between plants of Hedwigia dried under pressure and dried in the open, and you will easily see how important proper drying is for the student. My own practice is to place the mosses in an ordinary plant-press and press with medium pressure for twenty-

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four hours, and then remove and dry thoroughly in the open air. Mosses growing in thin mats are best spread out in the drying papers in their natural position, care being taken to remove any surplus of adherent substratum, soil, rotten wood, etc., also any other species that may be intertangled with the one it is desired to collect. If the mats are thick and consist principally of erect stems, it is better to break them up into vertical sections or slices before pressing. The substratum, the habitat, the locality, the date, and the name of the collector should be noted for each specimen, and either put in with the specimens or else recorded in a note-book, numbered to correspond to numbers attached to the specimens. The name of the person identifying the plant should also be written on the label. Many times it is also important to give the altitude at which the specimens were collected. The following is a good sample label:

NORTH AMERICAN MUSCI

Pseudoleskea rigescens *(Wils.) Lindb.*

Bark of Alder Trees. Alt. 1,800 ft.

Beaver Meadows, Vancouver, Id., Aug. 26, 1901.

Coll. J. W. Bailey. *Det. G. N. Best.*

When dried the mosses may be placed in suitable envelopes or pasted on cards, and preserved in an herbarium in the usual manner.

In the pronunciation of the scientific names it is well to remember that the best authorities give the English pronunciation of the Latin with the accent according to the rules of Latin grammar. The Roman pronunciation so much in vogue in schools and colleges is sure at some early date to supersede the English, but at present the English has the weight of authority.

The pronunciation is indicated by the same signs as in the recent works on the flowering plants.

\ Indicates the accent and the long, broad, open, or close English sound of the vowel.

/ Indicates the accent and the short English sound.

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Life History and General Structure.

THE fruiting moss plant consists of two distinct parts, the green leaf-bearing portion and the spore-bearing part—a slender bristle-like seta (sometimes almost lacking), bearing at its summit the capsule which contains the spores. The main use of the seta is to bear the capsules up above the surrounding plants to get light and air, and especially to place the spores where they will readily be distributed by the wind.

If you shake the freshly ripened capsule of any of the larger mosses you can easily see a small cloud of fine powder—the spores. If you mount such a capsule in water and press down upon the cover the mass of escaping spores can readily be seen.

When the spores fall on moist earth, under favorable conditions, they germinate by sending out tiny green threads called protonema; these continue growing until a green felt-like covering is formed over the bare soil or other substratum. From this protonema grow the moss plants.

If one examines damp earth that has been undisturbed for a few months he will readily find this green felt with tiny moss plants sticking up here and there. Greenhouses and old gardens are particularly good spots to search for this purpose. If one is fortunate enough to find fresh plants of the Slender Pogonatum the green protonema will be very conspicuous.

On the leafy portion of the plant are borne male and female reproductive organs, antheridia and archegonia. From the fertilized egg-cell in the archegonia develops the spore-bearing part—the sporophyte or sporogonium.

It is just as necessary that the spores of mosses be widely distributed as it is that the seeds of flowering plants be scattered far and wide, and very similar means are employed. The capsules of the Peat Mosses explode and shoot the spores as much as four inches into the disturbing breeze or onto the hair of passing animals. Webera and Buxbaumia are miniature powder guns fired by falling rain drops or by passing insects or other small animals.

By far the greater number of capsules are like miniature pepper boxes, shaking their life-bearing powder onto every breeze and shaken by every puff of wind and every passing object.

The mechanism of the boxes is most wonderful. The seta

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is often as full of spring as if it were tempered steel, and the little boxes are made with a lid which keeps everything snug until the spores are ripe, when it falls and leaves the perforated cover, which can open and close, open when dry and close when moist. In damp weather it closes so that the spores may not be beaten straight down by the rain or become wetted and spoiled inside the capsule by a premature germination. This automatic perforated cover is in most cases composed of a fringe of teeth around the mouth of the capsule; these teeth close up when moist and spread out when dry by a purely mechanical action which can be performed long after the cells of the capsule are entirely lifeless.

With the high power lens the teeth and cilia (see *Peristome* in Glossary) can readily be seen in a dry capsule which is well preserved.

In *Georgia* the capsules are erect, and its four teeth well separated when dry, as seen in Fig. 3, Pl. I. Dip one of the dry capsules in warm water for a moment and see the peristome close like a tiny vise, giving an almost comical impression of grim determination.

In *Polytrichum* the teeth are sixty-four in number, and of themselves are usually so short that they would have little effect on spore distribution, but they are all attached by their tips to the expanded membranous upper end of the columella, forming a most effective and ingenious pepper-box, entirely automatic in action. When the weather is dry, the teeth become shrunken in width, and strongly incurved; the columella also shrinks, pulling the ends of the teeth inwards (Fig. 2. Pl. I). This leaves ample room for the spores to be shaken through the openings between the teeth. The columella shrinks more at the margin than in the

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EXPLANATION OF PLATE I.

1. Moist peristome of *Polytrichum Ohioense*, R. & C. 2. The same dry. 3. Dry peristome of *Georgia*. 4. The same wet. 5. Four teeth of the peristome of *Catharinea undulata* (L.), Web. & Mohr. 6, 7, and 8 represent different positions of the peristome of *Barbula amplexa*, Lesq.* 7 shows the peristome immediately after the removal of the operculum. 8 shows the appearance of the peristome of a dry capsule from which the spores are escaping. The loosely twisted mesh of the narrow teeth forms a perfect sieve to control the escape of the spores. If you place a peristome in this condition under the microscope without mounting medium or cover-glass and breathe upon it the teeth will straighten perceptibly. If you dip it in warm water it will assume the original position shown in 7, if it be comparatively fresh; if it be rather old and somewhat broken it may look like 6. The perfect cone in 7 is, of course, a waterproof covering for the spores inside.

*As the peristomes were drawn by reflected light, the basal membrane was scarcely noticeable.

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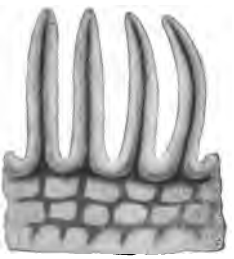
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PLATE I. (See explanation on preceding page.)

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central portion, causing it to assume the shape of a pie-plate. This upturned margin of the columella also enables the teeth to remain attached to its edge in their changed position. In species of this family with more nearly erect capsules the teeth are longer and often fewer in number, making the escape of the spores easier.

If you take a capsule in the condition represented in Fig. 2, and place it in warm water for a few minutes, it will assume the appearance shown in 1, and no spore can be shaken out; although a careful examination of the contents of the capsule will show that the spores are not wetted, for when mounted in water they are still surrounded by an envelope of air.

The pepper-box is closed, but how? Kerner von Marilaun† states that the teeth, when wet, curve inwards so strongly that the columella is pressed against the mouth of the capsule, closing it effectually. Five minutes' study, however, will show any one that the teeth do not curve in when wet, but, instead, straighten up and outwards; the columella also expands and becomes of nearly the same diameter as the capsule. This makes the openings lateral instead of terminal. The teeth expand enough laterally so that not a single drop of water can enter or a spore escape. In addition, the spores seem to be protected by the nature of their outer surface, for it takes a very long soaking to wet the spores so that they can be satisfactorily mounted in water for microscopic study.

Plate II, Fig. 2 shows the peristome of *Hypnum* in its dry state. Note how the cilia fill the spaces between the segments, forming a perfect sieve. Fig. 1 shows the same peristome wet and closed so tightly that no water can get in or spores get out. One can easily see from an examination of these two figures the advantage of having the segments alternate with the teeth.

This illustration is from a *Hypnum* with a strongly curved capsule. If an illustration were chosen from a species with an erect capsule the cilia would, in most cases, be more or less rudimentary and the segments narrowed, as is explained in the beginning of this topic.

In Fig. 4, the dry peristome of *Ceratodon purpureus* is shown. The loosely incurved teeth form a capital sieve. Fig. 3 shows the same ~~dry~~ wet. The peristome of *Dicranum,* shown in Figs. 5,

†Nat. Hist. Plants, 2: 814.

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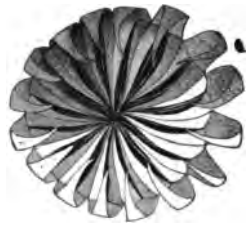
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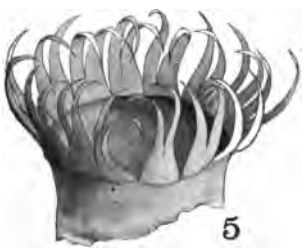
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PLATE II.

1. Peristome of *Hypnum,* moist. 2. The same dry. 3. The peristome of *Ceratodon purpureus,* moist. 4. The same dry. 5. A dry peristome of *Dicranum.* 7. The same moist. 6. The peristome of a *Dicranum* from which the operculum had just been removed.

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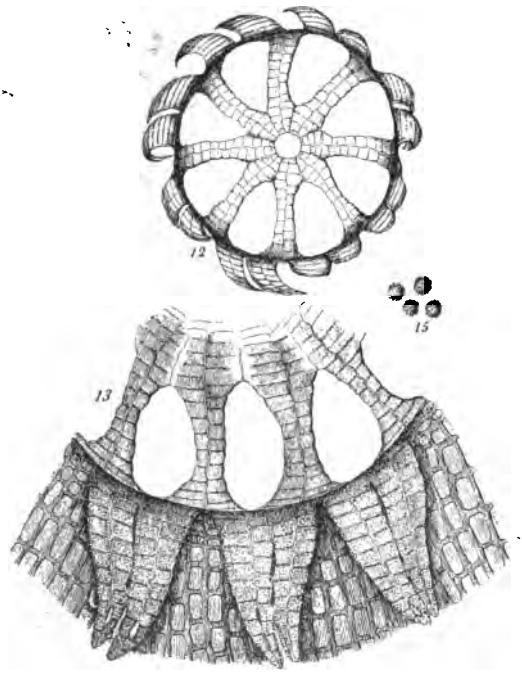

FIGURE 1.
Peristome of *Orthotrichum callistomum* (From Bry. Eur.)

6, and 7, is very similar to that of *Ceratodon,* only the teeth are broader and less incurved when dry.

In *Fontinalis,* which is always submerged, the peristome consists of a network, through the meshes of which the spores gradually escape. In a European moss, *Orthotrichum callistomum* Fisch., the inner peristome is a domelike structure with apertures near the base which are opened and closed by the hygroscopic teeth of the outer peristome.

This last is so curious yet so beautifully adapted for its work that it seems almost like a fairy tale, and would be scarcely credible if told of some rare unknown tropical plant instead of having been seen and described by several of the most matter-of-fact botanists. A somewhat similar arrangement is found in *Cinclidium stygium.*

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FAMILY 1. SPHAGNACEAE. The Peat Mosses.

THE Peat Mosses (Pl. III.) are so different from the other mosses that many bryologists do not consider them as mosses at all, but would put them in a separate class. Their protonema is much like the prothallium of a fern, and the stalk upon which the capsule is borne is not at all homologous with the seta of the other mosses, as it is an outgrowth from the gametophyte and not the lower portion of the sporophyte, i. e., it is developed from the moss plant instead of from the fertilized egg-cell. The structure of the leaves is also very different from that of the other mosses. The leaves of some species are pink or deep red and furnish microscopic mounts of very great beauty.

Although the *Sphagnaceae* consists of but one genus, the number of species is very large and the distinctions are very puzzling, so that only two or three of the commonest and most easily recognized species are here discussed.

Economically, the Peat Mosses are of more value than any others. In many portions of Ireland and Scotland peat is almost the only fuel supply of the peasantry. In the United States there is an abundant supply of peat. Dana estimates that there are 15,000,000,000 cubic feet in Massachusetts alone. Cheaper and more satisfactory fuels are so abundant that peat is little used in this country.

The memorable coal strike of 1902-03 called attention to our enormous and easily accessible supply of fuel of this sort, and some attempts were made to utilize this source of fuel supply. During the civil war, when coal was scarce and high-priced, peat was used to a considerable extent, and if coal should again become scarce and high-priced for any considerable time there is no doubt that the peat supply of our country could be made to furnish fuel for its needs for a century or more. At present it is not likely to compete with coal, because people are unfamiliar with its use, and the demand has not warranted any great investment in plants for scientifically preparing it for market. Those interested in the matter should read an article by Mr. S. Power, in the "Outlook" for January 17, 1903.

Peat Mosses grow in and near water in swamps. They keep growing at the top and dying below. Sticks, leaves, and other vegetable matter is washed in among the decaying stems.

DAYTON, OHIO.

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The whole mass, being saturated with water, decays slowly, leaving a black substance whose combustibility depends upon the purity of the carbon. The "muck" of the farmers is an incomplete or impure peat.

Peat Mosses grow into small ponds from the margin and frequently fill them entirely, forming quaking bogs. In other instances there is a small black pool in the center of the bog—all that remains of a much larger body of water that once occupied the whole area now occupied by the bog.

These bogs are very treacherous, and men and animals not infrequently perish through being engulfed in the black slimy mud. There is some antiseptic property in this mud which preserves animal and vegetable tissue for a long time. Huge logs are often dug out of these swamps in a condition fit for excellent lumber. In Ireland, the body of a woman dressed in haircloth was unearthed from under eleven feet of peat, where it must have lain for centuries.

Peat Mosses absorb water very freely and serve to hold back the water that falls during heavy storms, preventing floods and retaining the water until it is more needed. Because of this absorbent power these mosses are much used by florists for packing flowers and by stable-men for bedding.

Peat Mosses are dried and baled like hay and sent to the cities in great quantity for use in stables instead of straw. The moss absorbs liquids and gases so freely that stables using it are almost free from odor.

These mosses are easily recognized by their light gray-green color (sometimes pink or red at the top) and their peculiar shape, which is well illustrated in the figures.

Professor Goebel, in his Organography of Plants, gives an interesting account of the method of spore dispersal in Sphagnum. According to him, the ripening capsule absorbs air, and when fully ripe the sun's rays dry out the moisture, causing the capsule to shrink in all directions, but a great deal more transversely than longitudinally. This gradually compresses the air until the lid of the capsule is forced off with an explosion that has thrown the spores as far as four inches.

Although Professor Goebel did not mention it, it seems to me that this explosion is very probably "touched off" by passing animals or even by sudden breezes, so that the spores will find a ready means of dispersal. Certain it is that the spores will

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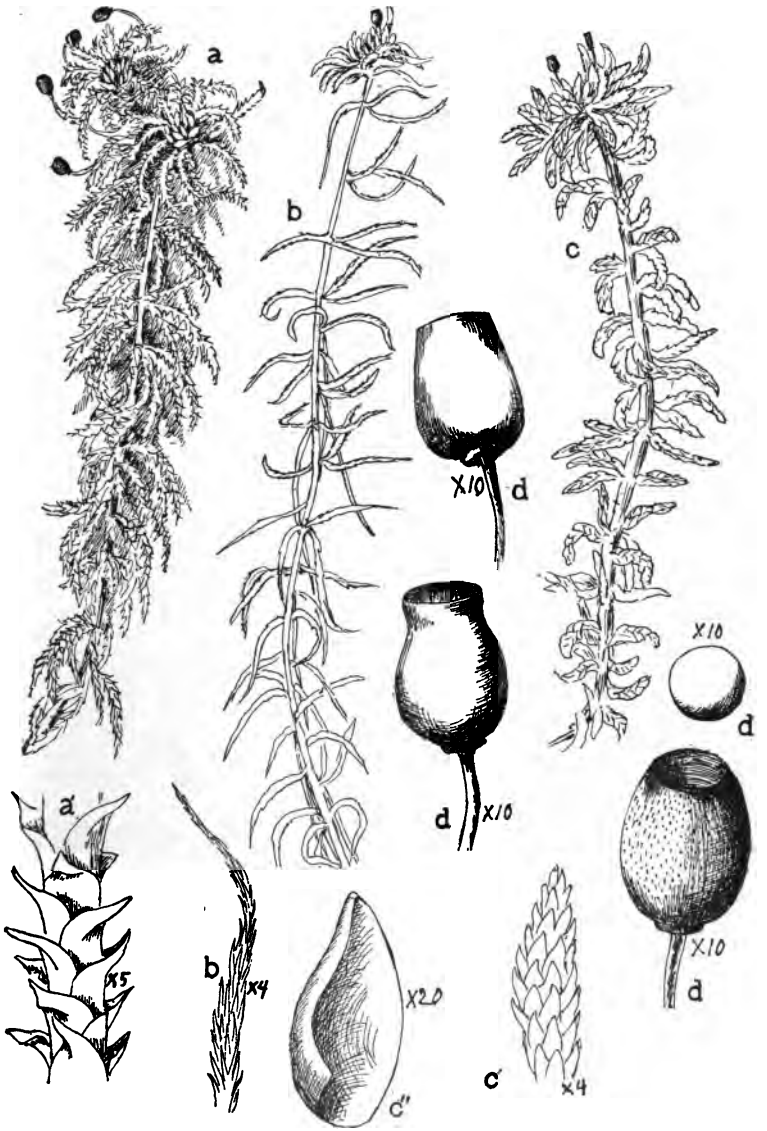

PLATE III.

a. Sphagnum squarrosum, Pers. *b. S. acutifolium*, Ehrh. *c. S. cymbifolium*, (Ehrh.) Hedw. *d.* Capsules of *Sphagnum*.

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escape in dry weather, which is most favorable for wide dispersion.

The Peat Mosses of Europe and America are the same in the main. There are, according to recent continental authors, a great number of species, which it requires all the trained ability of an expert to recognize. But for our purposes there are two easily recognized groups, each of which contains many so-called species.

The Spoon-leaved Peat Mosses, Pl. III, *c*, *c'*, *c''*, are easily recognized by their thick branches and their broad spoon-shaped leaves. The acute-leaved Peat Mosses are figured in *a*, *a'*, and *b*, *b*. Figure *b* represents the Acute-leaved Peat Moss, which is common in all the peat bogs of Europe and America. It is often tinged at the top with a bright red or crimson color. The Squarrose Peat Moss is one of the acute-leaved group, but is easily distinguished by the spreading tips of the leaves, as is indicated in Figs. *a*, *a'*. The branches are much stouter than in the Acute-leaved Peat Moss.

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FAMILY 2. ANDREAEACEAE. The Andreaèa Family.

THIS family is characterized chiefly by the dehiscence of the capsule, which splits into four valves after the manner of the Hepaticæ, the valves remaining attached at the apex. The plants of this family are all mosses of alpine or subalpine habitat, growing upon granitic or slaty rocks. The appearance is always dark, sometimes black, and the leaves are very brittle and dense. The presence of chlorophyll in the leaves is not apparent except in very young leaves. There is very little difference in the capsules of the different species.

ANDREAEA PETROPHILA Ehrh. is common on exposed rocks in the mountains of our range. It is easily distinguished from any species of Grimmia or Orthotrichum by its lack of costa, and it is much more slender than Hedwigia, and without hyaline points to the leaves. The other points in its structure are best made out from the illustration. It is abundant on the face of the Old Man of the Mountain in Franconia Notch, N. H.

A. ROTHII W. & M. (*A. rupestris* of many authors) occurs with the preceding and occasionally descends to lower levels on exposed rocks. It has been found along the Hudson, at Yonkers. It is easily distinguished from *A. petrophila* by the elongated-lanceolate

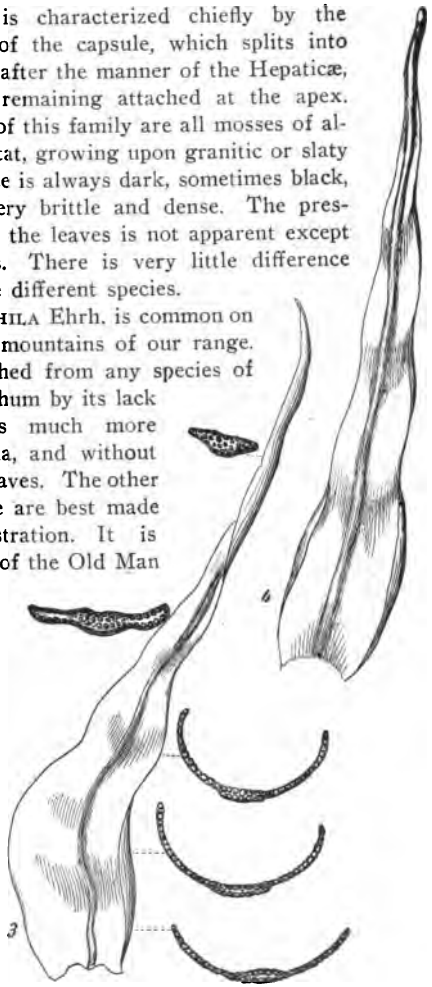

FIGURE 2. *Andreaea Rothii.* (From Bry. Eur.) Leaves and leaf sections.

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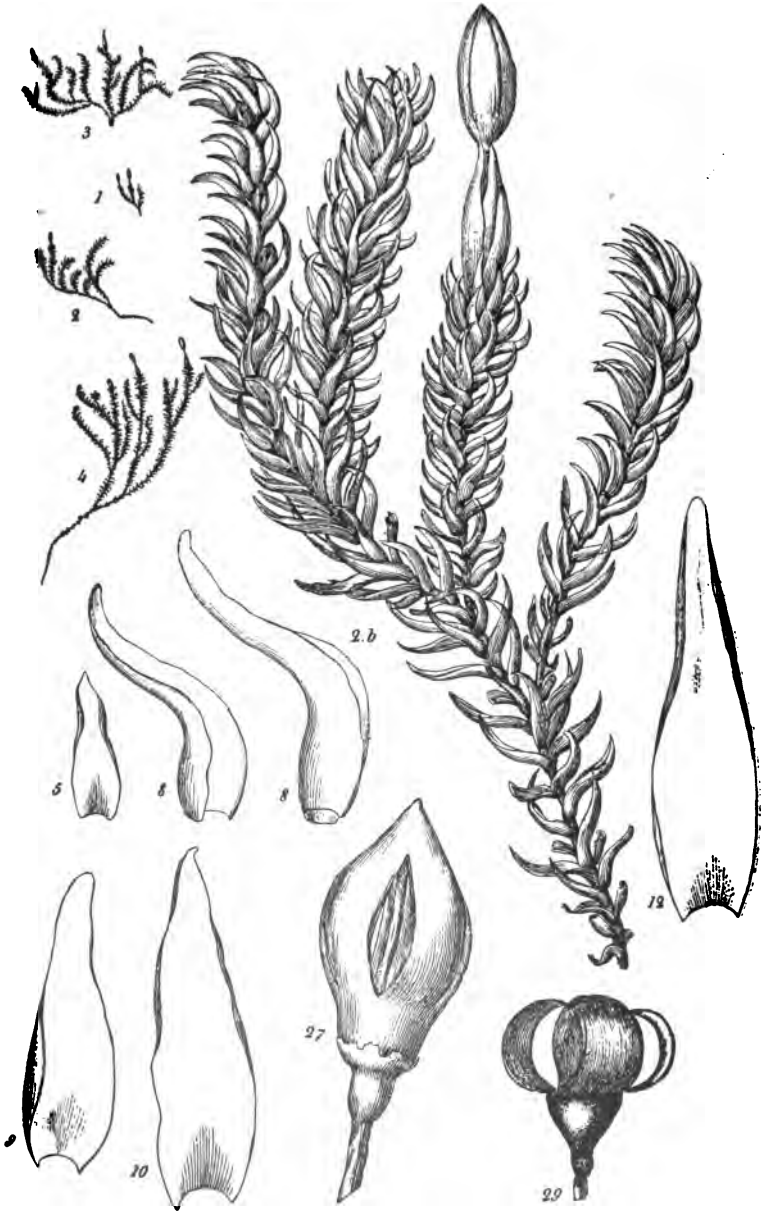

PLATE IV. *Andreaea petrophila* (From Bry. Eur.)
1-4. Plants natural size. 27 & 29. Capsules in different stages of drying.
The other figures are self-explanatory.

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leaves and the strong costa reaching to the apex of the leaf, or beyond.

The last species, if sterile, will be with difficulty distinguished from Grimmia, by one not familiar with it, unless comparison with authentic specimens is possible. The time of maturing spores seems to be spring in each of the species. In *A. petrophila* they mature in May and June.

FAMILY 3. GEORGIACEAE. The Georgia Family.

ALL of our mosses belonging to this family are distinct in the four-parted peristome, each of the four teeth being composed of a solid mass of cellular tissue. The leaves are ovate or lanceolate, costate, leaf-cells rounded-hexagonal.

GEORGIA.

The botanists of preceding centuries were often under royal patronage and frequently found it convenient to pay their respects to kings and queens. Thus, Georgia is named for King George III of England, and Catharinea for Empress Catharine II of Russia.

FIGURE 3.

a. Georgia pellucida, × 2. *b.* Gemmiferous branch, × 2. *c.* Capsule, × 10. *d.* Peristome, × 20. See also Plate I and Figs. 3 and 4.

G. PELLUCIDA (L.) Rabenh., the Common Georgia *(Tetraphis pellucida* of many authors), is very abundant on decayed stumps in moist woods. On the western end of Long Island, where decayed wood is scarce, it grows luxuriantly on the banks of brooks in swamps, the black peaty soil being as rich in organic matter as decaying wood.

The Flagellate Dicranum, which in New England grows almost exclusively on decayed wood, on Long Island and southwards has a habitat similar to that of Georgia. This goes to prove that some mosses growing on decayed wood are true saprophytes, although their saprophytism

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has not gone so far as to enable the plants to dispense with chlorophyll.

The Common Georgia has two characteristics that will serve to make its identification easy. Its peristome consists of four long teeth that are readily distinguishable under the lens. It is the only common moss with this number of teeth in the peristome. The other character is the possession of slender branches bearing cup-like clusters of leaves. In this cluster of leaves are minute green bodies, gemmæ, which fall off and give rise to new plants in the same way that the bulblets of Cystopteris give rise to that fern.

It fruits very abundantly and the capsules persist for a year or two, so that there is no difficulty in finding or identifying it. The capsules are in the best condition late in autumn.

G. Brownii (Dicks.) C. M. (*Tetrodontium Brownianum* Schwaegr.) is a very rare species found in less than half a dozen places in North America. It is a very small plant with a very few minute leaves at base; entire plant, including sporophyte, less than 1-3 inch in height; capsule oval, *teeth very broadly triangular,* almost equilateral. This species has been found in the mountains of Maine and New Hampshire and in Newfoundland. It often grows inverted on overhanging rocks.

Family 4. Polytrichaceae. The Hair-Cap Family.

THE plants of this family are usually of a large size, the simple or slightly branched stems growing from a creeping underground stem (except *Pogonatum brevicaule* and *P. brachyphyllum*). Leaves usually narrow, with the base sheathing or at least with the basal part of the leaf hyaline with larger cells; the costa bears on its upper surface, except at the hyaline base, *longitudinal strips of tissue (lamellae) one cell thick and attached to the upper surface of the costa by one edge,* making the costa appear very wide and dense. The upper leaf cells are usually hexagonal. The plants are usually dioicous with the *antheridia borne in conspicuous terminal rosettes.* The capsule is on a long smooth seta, large, cylindrical, or prismatic with 4-6 angles. The calyptra is cucullate, *covered with a dense felt of hairs, or at least roughened at apex with*

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short spinose projections. Peristome of 32 or 64 teeth, short, without joints, triangular in cross-section. Columella expanded at the top into a circular membrane, the epiphragm, which is attached to the tips of the teeth, and helps control spore distribution. (See Plate I.)

The plants of this family are among our most common and conspicuous species, and the student will be sure to fall in with them in his first day's study.

KEY TO THE GENERA.

1.	Capsules square or six-angled.....	*Polytrichum.*
	Capsules cylindric	2
2.	Calyptra hairy; leaves not crisped when dry.....	*Pogonatum.*
	Calyptra not hairy; leaves crisped when dry.....	*Catharinea.*

POLYTRICHUM. The Hair-Cap Mosses.

The Hair-Cap Mosses, called Bird Wheat or Pigeon Wheat in many localities, are the largest and most highly developed of all our mosses, and by reason of their size and common occurrence are familiar objects to nearly every one. Many an old field and meadow is carpeted with the dark rich green of the Common Hair-cap. The farmer, however, votes it a pest, as it often entirely supplants the grass over large areas of meadow.

The hairy cap that gives this genus of mosses its name is composed of long hairs growing from a little scale-like body, the calyptra proper, at the top of the capsule.

The Hair-caps, in common with most other mosses, are subject to great extremes of moisture and dryness, and their appearance when dry is very different from what it is when moist, as the leaves fold up against the stem to check the rapidity of evaporation. Some plants that do not produce a sporophyte end in a rosette of highly modified leaves. These are the male plants, and among the leaves of the rosette are numerous antheridia. The male plants of many other dioicous mosses end in a similar rosette. The leaves are large, not bordered, *with a sheathing membranous base* and very numerous lamellæ occupying the greater part of the width of the leaf above the base, making the central portion of the leaf very dark and dense. *Capsules prismatic, four- to six-angled,* often nearly cubical. Peristome teeth generally sixty-four.

Pogonatum is put with the Hair-caps by some authors, but is readily distinguished by the cylindric capsules. In other respects there is very little to distinguish the two genera.

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KEY.

1.	Leaf margins serrate, not infolded	2.
	Leaf margins entire, thin and infolded	4.
2.	Capsule four-angled	3.
	Capsule ovoid, obscurely 4- to 6-angled, beak long	*gracile.*
3.	Capsules cubical, beak short	*commune.*
	Capsules much longer than broad, beak long, neck tapering	*Ohioense.*
4.	Plants of dry situations, small leaves with long white awns	*piliferum.*
	Plants larger, leaves without white awns	5.
5.	Plants of lowlands without felted radicles; capsules 3 mm to 5 mm long	*juniperinum.*
	Plants of alpine or subalpine regions; stems covered with a dense felt of radicles, capsules 2 mm. to 3 mm. long.	*strictum.*

Our species are readily divided into two groups, as shown in the key. One with serrate plane margins and the other with margins thin and infolded, not serrate except at the extreme apex. The plants are so large and the characters so well defined that there will be no need to make use of microscopic characters except perhaps in the case of *P. gracile.* These species are all earth-growing.

P. COMMUNE L., Common Hair-cap, is our largest moss, sometimes having stems a foot long, although usually much smaller. It is one of the most widely distributed of plants, being found in all parts of North America, in Europe, and in Asia. It is also one of the very few mosses put to some economic use. The Laplanders use it to stuff pillows and beds. In England it is sometimes used for brooms.

A decoction of this plant was formerly much used to aid in the growth of the hair in accordance with the curious old doctrine of signatures which taught that the medicinal uses of plants were shown by their shape and structure; *e. g.* cordate leaves were supposed to be good for the heart and Hair-cap Mosses for the hair.

The leaves of the Common Hair-cap are very thick and strong, with a thinner clasping base and serrate margins. The young sporophytes appear in late autumn or early spring and the capsules mature in June or early July.

The Common Hair-cap is variable in nearly all its parts. The var. *perigoniale* is a form with very long whitish membranous and long-awned perichætial leaves. The var. *uliginosum* has the leaves spreading-recurved when dry; the stems more slender and less rigid than usual.

P. OHIOENSE R. & C., Ohio Hair-cap, without the capsule, is not readily distinguished from the Common, as leaves and

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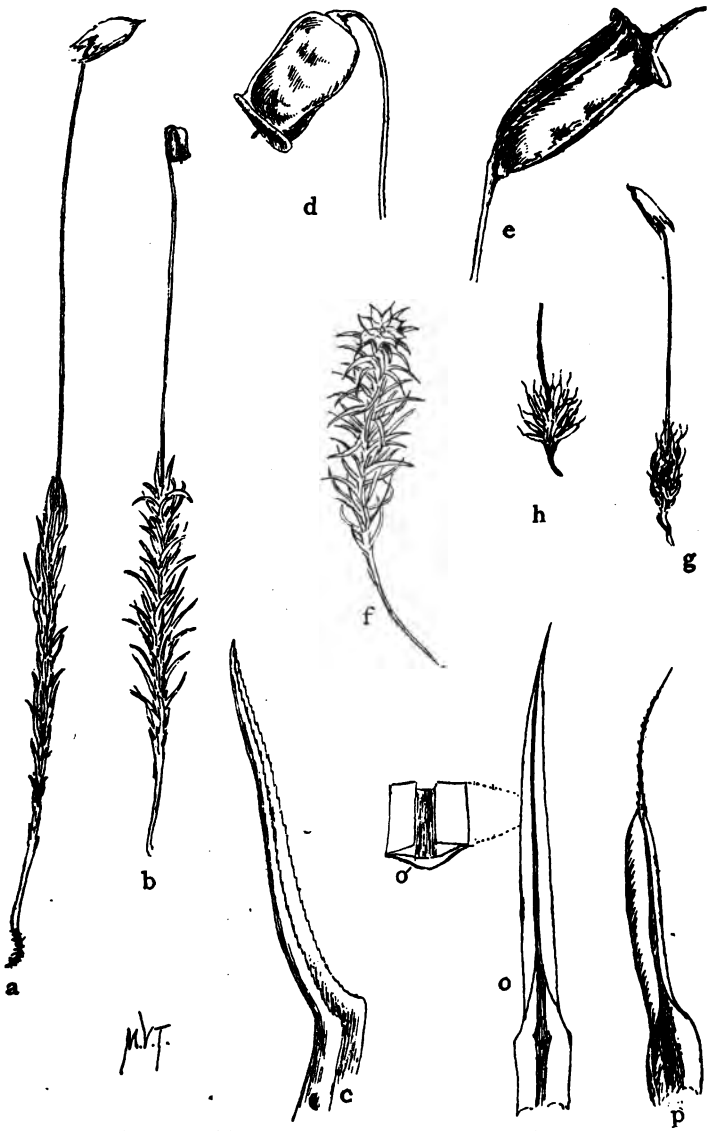

PLATE V. *a*. Fruiting *Polytrichum commune*, × 1. dry. *b*. The same moist with the calyptra removed. *c*. Leaf of the same, × 10. *d*. Capsule of the same, × 5. *e*. Capsule of *P. Ohioense*, × 5. *f*. Male plant of *P. commune*, × 1. *g* and *h P. piliferum*, dry and wet × 1. *o*. Leaf of *P. juniperinum*, × 10. *ó*. Portion of the same, × 30. *p*. Leaf of *P. piliferum*, × 10.

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general appearance are very similar. But with the sporophyte present the distinctions are clear. In Figs. *a, b* and *d, note* that the capsule of the Common Hair-cap is almost cubical, that the lid has a very short beak, and that the capsule is entirely covered by the calyptra. The capsule of the Ohio Hair-cap (*e*) is elongated, slender, with a tapering neck; lid much longer-beaked. The lid and the calyptra of the Ohio Hair-cap fall early in June, very soon after the spores are ripe, and it is not always easy to find either in position; but, if the calyptra be found, it will be seen to cover the upper portion of the capsule only. The Common Hair-cap, although occurring in woods, is most common in open fields. The Ohio Hair-cap is most frequent in shady, more moist spots, often in deep woods.

P. GRACILE Dicks. is a rare form, which I believe is often confused with *P. Ohioense*. The length and the number of angles of the capsule are somewhat variable, although the capsules usually have more than four angles. Microscopic sections of the leaves are necessary definitely to determine this species.

P. JUNIPERINUM Willd., Juniper Hair-cap, resembles *P. commune* very closely in general appearance except for the light *glaucous-green color of its open leaves,* so different from the dark green of the latter that they are strikingly distinct at a glance when moist, especially if the two species are growing intermingled, as they often do. It usually grows in drier situations than *commune*. A glance at the upper surface of the margins of the leaves under a hand-lens will serve to distinguish the two species without the shadow of a doubt. This species matures its spores at about the same time as *commune* or possibly a little later.

P. PILIFERUM Schreb., the Awned Hair-cap, has the same light color as the preceding and also has its leaf-margins turned in, but the leaves differ in shape as shown in the figure, and end in long white awns. The entire plant is much smaller than in any of the other species, rarely growing larger than the figure. It also grows in much drier places than the other species, the thin layers of soil around the edges of ledges in dry pastures being a favorite habitat. It matures in June and July.

I have found this species on ledges next the bare rock, next it but farther from the ledge the Juniper Hair-cap, and in moist depressions in the ledge the Common Hair-cap, growing on the accumulated soil and humus.

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P. STRICTUM Banks, will surely be found by all mountain climbers. It is very common in open boggy places at an altitude of 3,000 feet or more. It is closely related to *P. Juniperinum,* but is readily distinguished by the *more slender, densely radiculose* stems and the *much smaller capsules.*

POGONATUM.

The Pogonatums differ from the Hair-caps mainly in the cylindrical capsules, not square or angular in section. The teeth are thirty-two and the capsules are straight or curved. The spores mature in autumn or winter, except in *P. alpinum,* in which they mature about July.

KEY.

1.	Stems branching	2.
	Stems simple; leaves numerous, strictly alpine, growing close together	*capillare.*
	Stems simple; leaves few, radical; protonema persistent, forming a green layer on which the plants are scattered; plants of low and median altitudes	3.
2.	Plants dark green; capsules smooth, curved	*alpinum.*
	Plants glaucous; capsules papillose, erect or very nearly so	*urnigerum.*
3.	Leaves lanceolate-subulate, serrate	*brevicaule.*
	Leaves lingulate, blunt, entire	*brachyphyllum.*

P. BREVICAULE (Brid.) Beauv., the Slender Pogonatum, [*P. tenue* (Menz.) E. G. B.] is probably the most common of our species. It grows on bare moist banks of clay or loam where other plants have not yet obtained a foothold. The plants do not grow close together, as with most mosses, but *singly and scattered, the soil between them being covered with green felt-like protonema.* All mosses grow from just such green felt; but after the moss plant proper has developed, the protonema usually disappears. In *P. brevicaule,* however, the protonema is persistent and plays an active part in the nutrition of the plant, seeming to perform the function of leaves, for the leaves on this plant are very few and short as compared with the allied species. This is well illustrated by the figures, the dark shaded upper portion of the leaf being the only part that contains chlorophyll and therefore the only portion that performs the functions of a leaf. These marked and interesting modifications may be due to the fact that this moss grows on freshly disturbed earth, and by this method is enabled to fruit before its competitors for the space are able to develope. The capsules mature in late autumn.

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PLATE VI. *a. Pogonatum brevicaule*, × 2. *a'. Leaf*, × 15. *a''. Capsule*, × 10. *b. P. urnigerum*, × 2. *b'. Leaf*, × 10. *c. P. alpinum*, × 2. *c'. Leaf*, × 10. *c''. Capsule*, × 10.

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P. BRACHYPHYLLUM (Mx.) Beauv. is found on sandy and loamy soil, in the New Jersey pine barrens and southwards. It is very much like *P. brevicaule,* but is easily distinguished from it by *its entire leaves.* It need not be looked for in the northern part of our range.

P. ALPINUM (L.) Roehl. is common in woods and shady places, especially in elevated regions; thus it is at once recognized by its larger size and longer curved capsule with long-beaked operculum. The leaves, also, are much longer and more slender. Without the capsules this species is most likely to be mistaken for some of the Hair-caps. Its capsules mature in June or early July.

P. URNIGERUM (L.) Beauv., the Urn-like Pogonatum, grows in woods and shady places, preferring elevated regions. It is not uncommon and in some localities may be even more common than either of the species mentioned above. I, however, have met with it much less frequently. It is at once distingushed from *P. alpinum by its straight erect capsule,* which is scarcely to be distinguished from that of *P. brevicaule.* It is usually smaller than the *P. alpinum* and much larger than the *P. brevicaule,* but is so variable that this is not to be depended upon. Its leaves, however, will serve to distinguish it readily from *P. brevicaule,* when its size is deceptive. The capsules mature in autumn.

P. CAPILLARE (Mx.), Brid. will be found on most of our higher mountain-tops. It has broad leaves like those of *P. urnigerum,* but they are much more strongly curved when dry. It is also much smaller, with simple unbranched stems and shorter capsules.

CATHARÍNEA.

The Catharineas are very closely related to the Hair-caps, but have the calyptra nearly bald. It is merely roughened with a few vestigial hairs. For this reason it has been called Atrichum, meaning without hairs. Polytrichum means many hairs. The leaves are not sheathing and but slightly embrace the stem, lingulate or ovate-oblong, crisped when dry; margins bordered, serrate, teeth often in pairs. Capsule cylindric, often somewhat curved; operculum long rostrate; peristome of thirty-two teeth.

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The capsules of the Catharineas are in good condition from late autumn to early spring.

KEY.

1. Capsule 4: 1; leaves not at all wavy on the margins when moist, midrib narrow ..... *crispa.*
   Capsule 6-8: 1; leaf margins wavy when moist ..... 2.
2. Midrib constituting 1-8—1·10 of leaf ..... *undulata.*
   Midrib constituting 1-3—1-4 of leaf ..... *angustata.*

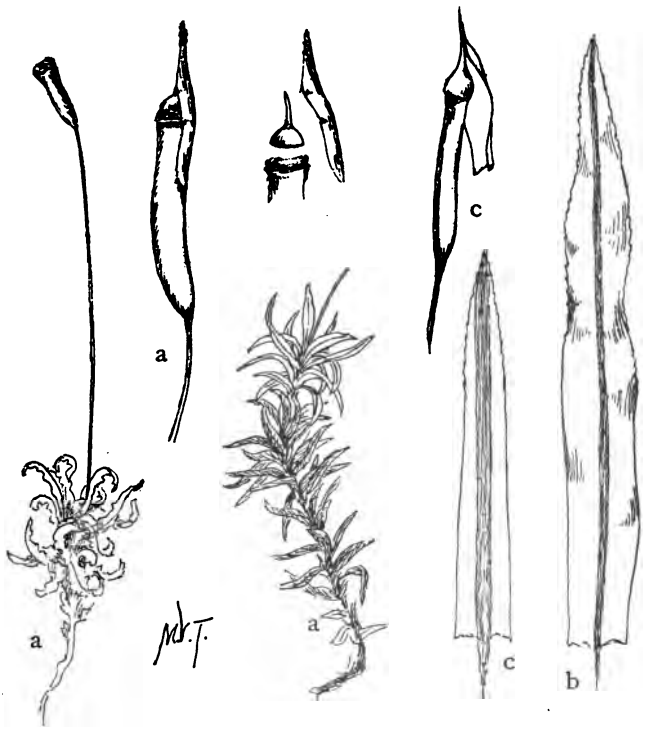

FIGURE 4.

a, a, a. Catharinea undulata, wet and dry, × 2, and capsule × 5. *b.* Leaf × 10. *c, c.* Capsule and leaf of *C. angustata* × 5 and 10, respectively.

C. UNDULATA (L.) W. & M., Wavy Catharinea. Leaves lingulate, strongly undulate when moist and strongly spined at the back. Occasionally specimens are found with two or more setæ from a single plant.

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The Wavy Catharinea is one of the very common mosses, occurring everywhere in eastern North America. It seems to be rather rare on Long Island, but in most parts of the country it is exceedingly common. It grows best on moist shady banks of brooks. It can easily be recognized by its long slender slightly curved capsules, leaves strongly crisped when dry, and the narrow midrib due to few and short lamellæ. (See glossary).

C. ANGUSTATA Brid., Narrow-leaved Catharinea, resembles the Wavy Catharinea very closely, but grows in dryer, more sandy soil, and is usually much smaller with narrower straighter capsules, as shown in the cut. The only sure way to distinguish them is by the leaves. The differences are shown in the cut. Although the leaf of the Narrow-leaved Catharinea is narrower, the midrib is much broader, constituting one-third to one-quarter the breadth of the leaf.

FIGURE 5.
Catharinea crispa, x 1.

C. CRISPA James is a rare species in most parts of the country, but it is common in swamps along the south shore of Long Island. It will probably be found fairly common along the Middle Atlantic coast.

Its leaves are oval-oblong, thrice as broad in proportion to their length as those of *C. undulata, not at all wavy when moist, and not spinose upon the back;* the lamellæ appear as darker lines on the costa, but do not materially increase its apparent width. The capsule is much shorter than in either of the other species. When sterile, this species is almost sure to be mistaken for a *Mnium.*

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FAMILY 5. BUXBAUMIACEAE. The Buxbaumia Family.

THE plants of this interesting family are small, almost or quite stemless, with leaves few or none. They grow on earth or rotten wood. Perichætial leaves present but often disappearing long before the maturity of the capsule. Capsule very large in proportion to the size of the plant, oblique and asymmetric. Calyptra small, conical. Peristome single or double, forming a whitish cone.

A most peculiar and fantastic family, the members of which will readily be recognized by a comparison of the figures given under the species.

BUXBAUMIA.

The drawings speak for themselves. No one who finds the queer looking objects figured here will have any difficulty in identifying them.

The leaves are few and are clustered at the base of the seta. They entirely disappear before the capsule ripens, so that the mature plant consists of only the roughened seta with a few rhizoids at the base and the queer bug-like capsule. Mrs. Britton calls the Buxbaumias "The Humpbacked Elves." To the author they look like bugs on a stick. We have two species in eastern North America, *Buxbaumia aphylla* L., and *B. indusiata* Brid.

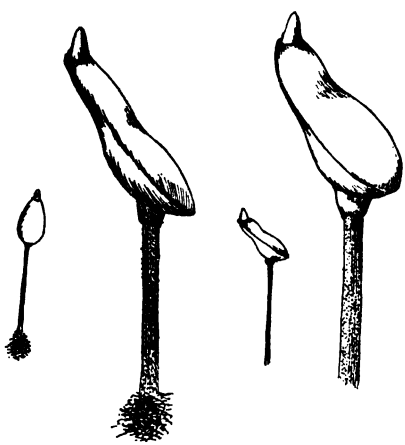

FIGURE 6.
Two different views of *Buxbaumia aphylla*, × 1. Two different views, × 4.

B. APHYLLA has the capsule red-brown, shining, strongly flattened above; outer peristome of a single series of *very short teeth;* spores maturing from December to June, occasionally found mature in September. Plants growing on soil.

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B. INDUSIATA has the capsule green or yellow, dull, little flattened above; outer peristome of four concentric rows of linear teeth, of which the outer row is short and the inner more than half the length of the cone; spores maturing a month or so earlier than in the preceding. Plants growing on very rotten wood, rather smaller. Both species are widely distributed across the continent, but *B. aphylla* is much the more common.

WEBERA.*

Much more common than Buxbaumia and scarcely less interesting is the odd little Webera shown in Fig. 7. The capsules have much the same one-sided tilt, but are less irregular in outline and are partially incased in the fringed perichætial leaves. The capsule resembles a grain of wheat in appearance and is almost sessile, the seta being so short as to be scarcely apparent. The leaves are persistent and the non-fruiting plants are frequently so abundant as to make a broad mat of dark green, dotted here and there with the lighter colored capsules. In looking for Webera search for a moist bank where there is little or no tall vegetation, and which at a little distance appears dark green mottled with white. (The white is a lichen that is nearly always found with the Webera.) Webera is so common and so easily recognized that every lover of mosses should be able to collect it in his home locality. The capsules persist for a long time, but July is a good time to collect this species.

FIGURE 7.

a. Webera sessilis, × 4. *b.* Leaves, × 4. *c.* Perichætial leaves, × 4. *d* and *e.* Peristome and operculum, × 10.

In Webera, as well as in Buxbaumia, the upper surface of the capsules is flattened in cross-section and the capsules all point in the direction of the light supply, often looking like soldiers in close array at "shoulder arms." Both the position of the capsule and the flattening of the upper surface is an adaptation for light absorption, but in Webera the first drops of rain that

*We have but one species of Webera, *W. sessilis* (Schmid .) Lindb.—*Diphyscium foliosum of many authors.*

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fall in a storm strike the upper surface (Vide "Goebel Organography," Pt. I, p. 237, Balfour's translation) and send the spores out in little puffs, sometimes to a height of two inches. This effect can be produced by tapping a mature deoperculate capsule lightly upon the upper side. Note how the nozzle-like peristome is pointed straight up so that the spores are fired as high as possible from the miniature powder gun. It seems probable that the wind which accompanies summer storms serves to further disperse these spores and that the ejection of the spores ceases after the capsules are well wetted; but this needs further investigation.

It also seems perfectly sure that other agencies than raindrops will serve to force the spores out of Webera and Buxbaumia's "powder guns;" for example, the impact of the feet of large insects and other small animals. Perhaps the jet of spores may leave some clinging to the hair or fur of the animals which discharge them, and through that means they may be carried for considerable distances.

FAMILY 6. FISSIDENTACEAE. The Fissidens Family.

THIS is one of the most natural and easily recognized of the families of mosses. Only one genus, Fissidens, is common and the characters of this genus are the characters of the family for the most part.

FISSIDENS.

The leaves of Fissidens are in two rows on opposite sides of the stem and both rows lie in the same plane, giving the plants a peculiar flattened appearance like a Hepatica. The leaves are vertically placed and apparently split along the basal portion of the upper margin so as to clasp the stem and the base of the leaf next above.

The leaf-cells are small, rounded or hexagonal. The sporophyte

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PLATE VII. *Fissidens adiantoides.* (From Bry. Eur.).

5. Plant natural size. 8. Perigonial leaf. 9-11. Leaves. 11 x. Cross sections of the lower part of leaf. 11 a. Apex showing border of lighter cells.

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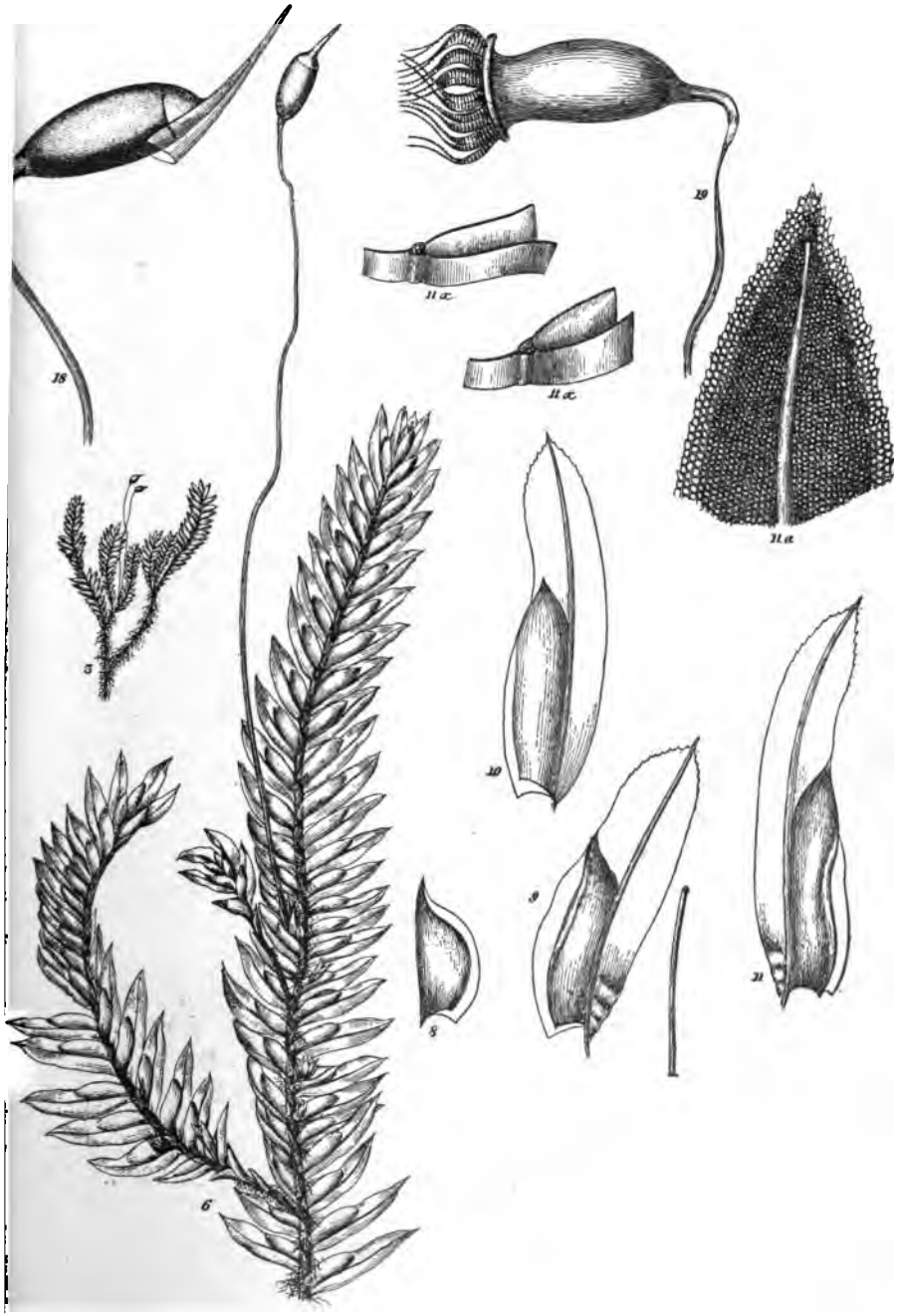

PLATE VII. (See explanation on preceding page.)

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is lateral or terminal, exserted; peristome like that of *Dicranum,* with sixteen forked, highly colored teeth, which are often papillose above.

The peculiar structure of the leaf has been explained in several ways, but the explanation given by Robert Brown in 1819 has recently been verified by the studies of Mr. E. S. Salmon.

According to this theory the clasping portion of the leaf represents the original leaf, while the rest of the leaf is made up of lamellæ, one dorsal and the other terminal. This theory is strongly confirmed by the fact that these supposed lamellæ are wanting in the perigonial leaves and very much reduced in size or wanting in the lower-stem leaves. Moreover, the peristome shows this family to be closely related to the *Dicranaceae,* in which dorsal lamellæ are often strongly developed.

The leaves are often bordered, sometimes with a number of elongated cells, much as in *Mnium,* but, more frequently, with cells of the same shape and size but of a different color; the border is usually too narrow to be distinctly made out with a hand-lens.

F. CRISTATUS Wils. is apparently the most common species. It grows on moist soil or stones in shaded places. The *sporophyte is lateral* and the leaves are margined with a border of lighter cells as shown in the plate of *F. adiantoides.*

F. ADIANTOIDES (L.) Hedw. can be told from *F. cristatus* with certainty by the compound microscope alone. The latter species seldom reaches more than an inch and a quarter in height while *F. adiantoides* may be two or three inches high. Both species mature their spores in winter.

F. OSMUNDIOIDES (Swtz.) Hedw. is one-fourth to two inches in height (rarely twice this); leaves not bordered; dioicous; with *terminal sporophyte;* capsule suberect or inclined; operculum with a needlelike beak nearly as long as the rest of the capsule. Spores mature in *summer* (July). Common on various substrata.

F. TAXIFOLIUS (L.) Hedw. is usually

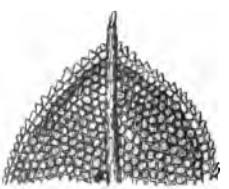

FIGURE 8.
Leaf-apex of *F. taxifolius.*
(From Bry. Eur.)

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PLATE VIII. *Fissidens Julianus* (From Bry. Eur.). 1 and 2. Plants natural size.

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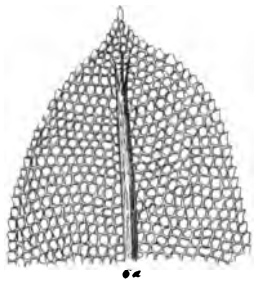

FIGURE 9.

Leaf-apex of *F. osmundioides*. (From Bry. Eur.)

less than ½ inch *in height; sporophyte lateral;* capsule inclined, often cernuous; beak of operculum long, usually bent at base; spores maturing in late autumn or winter. On damp clayey soil. Its "ear-mark" is the *excurrent costa.*

F. JULIANUS (Savi.) Schimp. grows on stones in brooks and looks like a small *Fontinalis.* The lens readily shows the leaf structure to be that of *Fissidens.* This species is frequent in brooks in New York and New Jersey in the vicinity of New York City. (See Pl. VIII.)

FAMILY NO. 7. DICRANACEAE. The Dicranum Family.

THE plants of this family vary in size from exceedingly minute to several inches in height. The leaves are broadly lanceolate to subulate, often sheathing at base, costate; leaf-cells square, or rectangular to linear, filled with chlorophyll above, more elongated and with little or no chlorophyll toward the base, often with special inflated cells at the basal angles. The calyptra is smooth, narrow, and cucullate. The capsules are on elongated setæ, narrow, oval to cylindrical, frequently cernuous and curved; operculum usually long-beaked; peristome of 16 teeth which are *cleft half-way to the base or further into two lanceolate or subulate divisions,* usually of a reddish color, transversely barred.* There are a few cleistocarpous species with capsules rounded and immersed or elongated and exserted.

The leaf character and the peristome when present will usually indicate the family to one who is at all familiar with it. The plants of this family are inhabitants of soil and rocks, rarely growing on trees, frequently on decaying wood.

*For an illustration of a Dicranum peristome and a description of its workings see p. 9.

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FIGURE 10. *Pleuridium subulatum* (From Bry. Eur.)
1. Plant natural size. 3. Basal part of stem with leaves. 4, 5, and 6 are leaves from different parts of the stem.

PLEURIDIUM.

Pleuridium and Bruchia are both exceptions to most of the statements made above, as they are degenerate members of the family.

P. SUBULATUM (L.) Rabenh. Down among the tufts of grass in dry and sandy fields in early spring, one can find soft silky tufts of green containing innumerable little green spheres like

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emerald dewdrops. These green spheres are the capsules nestling among the leaves because of the shortness of the setæ. The drawing can give no idea of the beauty of a dense tuft several inches square, fresh from the field, wet with the spring snows and rains.

The plants are one-twelfth to one-eighth inch high; the spores mature from April to June. Not uncommon in old fields on sandy banks, etc., less frequent northwards.

As shown in the figures the leaves taper gradually to the apex. In *P. alternifolium* which is not rare near the coast, the plants are about one-fourth inch in height and have many of the leaves so suddenly narrowed as to resemble a ladle in outline.

BRUCHIA.

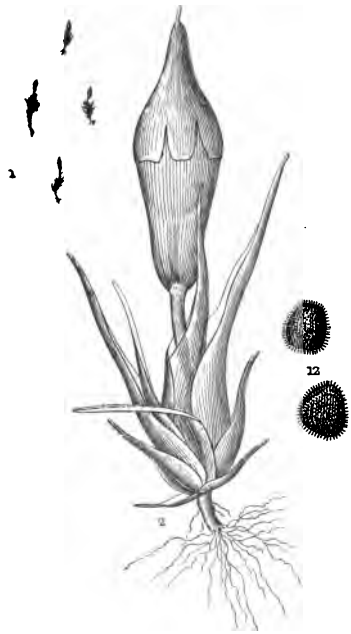

FIGURE 11. *Bruchia Sullivantii.* 1. Natural size. 2. Magnified. (From Sulliv. "Icones.")

Bruchia is named after one of the famous old world bryologists, Ph. Bruch, one of the authors of the great Bryologia Europea, from which many of our illustrations are taken. Our most common species is

B. SULLIVANTII, named by Austin after Sullivant, the greatest American bryologist, so that this little plant is very interesting for its name alone. It may be found growing with Pleuridium, but it is at once distinguished by its partially exserted, pear-shaped capsule and mitrate calyptra. Its spores mature about two weeks later than those of *Pleuridium subulatum*. Neither Pleuridium nor Bruchia have lid or peristome, but set free their spores by the irregular breaking apart of the capsule (cleistocarpous).

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ASTOMUM.

A. SULLIVANTII Schimp. is associated in habitat with the two mosses mentioned above and is also small and cleistocarpous so that it is better to treat it here, although it belongs in the Tortula family. The plants are larger than in Pleuridium or Bruchia and are readily distinguished when dry by the spirally twisted leaves and also by the fact that the spores begin to mature in the fall. The plants without fruit much resemble *Weissia viridula* and the cuts of that moss will help in the study of the leafy part of this. The lower part of the stem is omitted in the cut and the capsules are usually much more concealed by the leaves when dry; indeed they are so hidden as to be often overlooked, the plants are undoubtedly mistaken for sterile *Weissia viridula*.

FIGURE 12. *Astromum crispum* (From Dixon and Jameson.) Scarcely to be distinguished from *A. Sullivantii* with the hand-lens.

DITRICHUM.*

D. VAGINANS (Sulliv.) Hampe, the Dark Ditrichum, has a habitat very similar to that of Ceratodon and at first sight might be confused with it. The capsules are much the same color and somewhat furrowed, but it is smaller with more erect symmetric capsules that have much less conspicuous furrows when dry. It matures its spores late in autumn, which of itself will be sufficient readily to distinguish it from Ceratodon. It is not frequent in the more northern portion of our range.

D. TORTILE (Schrad.) Hampe, the Brown Ditrichum, is frequent throughout in moist sandy or gravelly soil by roadsides and in old fields. It is closely related to the preceding, but is smaller, with light brown capsules which mature at about the same time and are smooth when dry.

It is more common than the Dark Ditrichum, especially northwards. It grows in more moist places of the same general nature, being especially fond of moist banks of recently disturbed

*_Ditrichum_ Timm.=_Leptotrichum_ Hampe.

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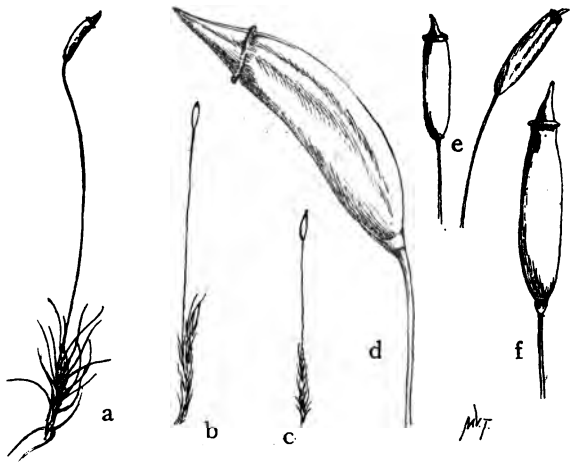

FIGURE 13. a, b, and c, *Ditrichum pallidum, vaginans and tortile* respectively, × 2. d, Capsule of *D. pallidum* × 20. e, Capsules of *D. vaginans* × 10. f, Capsule of *D. tortile* × 20.

soil, which as yet have not become occupied with other vegetation. The young sporophytes sometimes bend over towards the light until they are parallel with the incident solar rays, so that the young green capsules with their abundant assimilative tissue are equally illuminated on all sides. Such plants remind one very strongly of house plants in a window. Its spores mature in autumn. It is a most variable species in pretty nearly every character.

These two species often grade into each other and the Dark Ditrichum is probably only a variety of the Brown.

The Red Didymodon [*D. rubellus* (Hoffm.) B. & S.] somewhat resembles the Dark Ditrichum, but is more red than brown and its leaves are two or three times as long and somewhat curled when dry. It belongs in the Tortula family, although evidently related to the Ditrichums.

D. PALLIDUM (Schreb.) Hampe, the Yellow Ditrichum, is more abundant southwards and in the lowlands, and is much larger than the other two species. It is easily recognized by its bright yellow setæ and unsymmetric capsules, which mature in late spring. It is most frequent in dry sandy soil.

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ONCÓPHORUS. (Cynodontium Schimper).

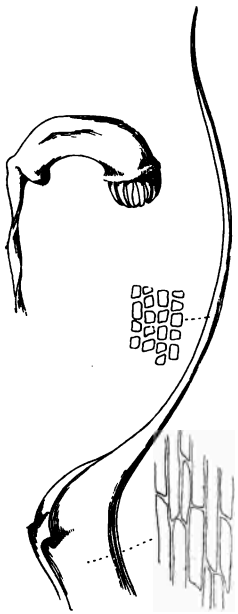

FIGURE 14.

Capsule ×13, leaf × 10, and leaf cells × 200 of *Oncophorus Wahlenbergii.*

The species of this genus are as a rule alpine or subalpine, but one of the number,

O. WAHLENBERGII Brid. is frequent enough to warrant mention here. This is a pretty little moss growing on rocks and soil in cool situations in or near the mountains. Its crisped spreading leaves, somewhat resembling *Dicranum fuscescens* in appearance, with their suddenly dilated bases, and the arcuate, smooth or irregularly-wrinkled, plainly strumose capsule render it easy of recognition by one who has ever seen it before.

CERÁTODON Brid.

C. PURPUREUS (L.) Brid., our only species, is one of the commonest of all our mosses. It is found on the edges of paths, roofs of old buildings, sand by the seashore, and in general any barren compact soil is its favorite habitat. The plants are short and grow close together, forming dense thin mats of dark green. The lance-like young sporophytes appear early in spring as soon as the snow is melted. By the middle of the summer the capsules often decay beyond recognition and the seta breaks from the plant at the touch.

Unless one has become familiar with Ceratodon it is not always easy to recognize it without mature capsules.

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FIGURE 15.

Ceratodon purpureus × 2. Leaves, calyptra, and capsule × 10.

The leaves may be entire or slightly denticulate at apex, and the costa is sometimes percurrent or even excurrent. The stems sometimes become three inches long in shaded places.

When the capsules have fully matured they shrink when dry and become furrowed. This peculiar furrowing and the dark rich color of the capsules, a color called purple by the older botanists but which is really a very dark chestnut or red-brown, make it easy to recognize. The peristome is shown in Plate II.

Aulacomnium palustre has a capsule furrowed in a similar manner, but it is easily distinguished by the characters noted under the description of that genus.

TREMATODON Mx.

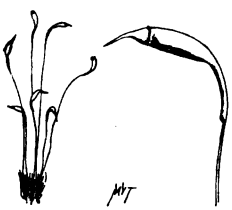

FIGURE 16.

Trematodon ambiguus ×1, and capsule ×5.

T. AMBIGUUS (Hedw.) Hornsch., the Long-necked Moss, is so odd in appearance that it will need little description. It is not common, but will be met with occasionally in rather dry soil in copses and old fields where the grass is thin. Besides the long neck, *the bright yellow setae,* closely resembling those of *Ditrichum pallidum,* are an additional aid in identification. The capsules mature in summer.

T. LONGICOLLIS Mx. is easily distinguished by its much longer neck, *twice the length of the rest of the capsule,* which is more cylindric than in *T. ambiguus.* Moist clayey or sandy soil in the southern part of our range and southwards.

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DICRANELLA.

Plants small, like miniature *Dicrana,* scarcely branched. Leaves lanceolate-subulate, without specialized angular cells. Capsule short, erect or inclined, frequently striate; lid beaked; peristome dicranoid, of 16 teeth, cleft to the middle into two filiform divisions.

The small size and narrow silky leaves, narrowed gradually or abruptly from a broader base to a channelled subulate apex, render the genus easy of recognition, especially if the dicranoid capsule be present. The capsules present variations similar to those of *Dicranum,* but capsules that remain erect and symmetric when dry and empty are rare; dioicous.

KEY.

1.	Seta yellowish, sometimes becoming dark with age	2.
	Seta red	3.
2.	Capsule oblong, tapering at the neck, sulcate, mouth incurved when dry	*heteromalla.*
	Capsule oblong, tapering at the neck, scarcely plicate, mouth erect when dry	*heteromalla Fitzgeraldii*
	Capsule gibbous, strumose at neck, smooth when dry	*cerviculata.*
3.	Leaves scarcely secund, not pellucid	*varia.*
	Leaves secund or erect, pellucid by reason of very large thin-walled cells	*rufescens.*

D. HETEROMALLA (L.) Schimp. is our only common species. It is found on shaded, sandy banks throughout our range. The plants are simple or forked, one-half inch to two inches in height, and grow in dense tufts or sheets of various shades of green from bright yellowish to dark. The leaves are falcate-secund, gradually narrowed from the base so that the lower portion of the leaf has a triangular form; the upper part is subulate, and channelled with costa percurrent or excurrent. The seta is *yellow,* becoming dark with age; capsule oblong to oblong-ovoid, suberect, typically slightly curved, brown when dry and empty, and furrowed and *constricted below* the mouth *with the mouth oblique in a very characteristic manner;* operculum rostrate, oblique.

The obliquity of the mouth and the deepness of the furrows in the capsule walls seem to be progressive with age. The capsules mature in November and December, but do not as a rule appear to assume their characteristic pose until spring. This fact accounts for some of the discrepancies in descriptions, especially of the varieties, although the species as a whole is exceedingly variable.

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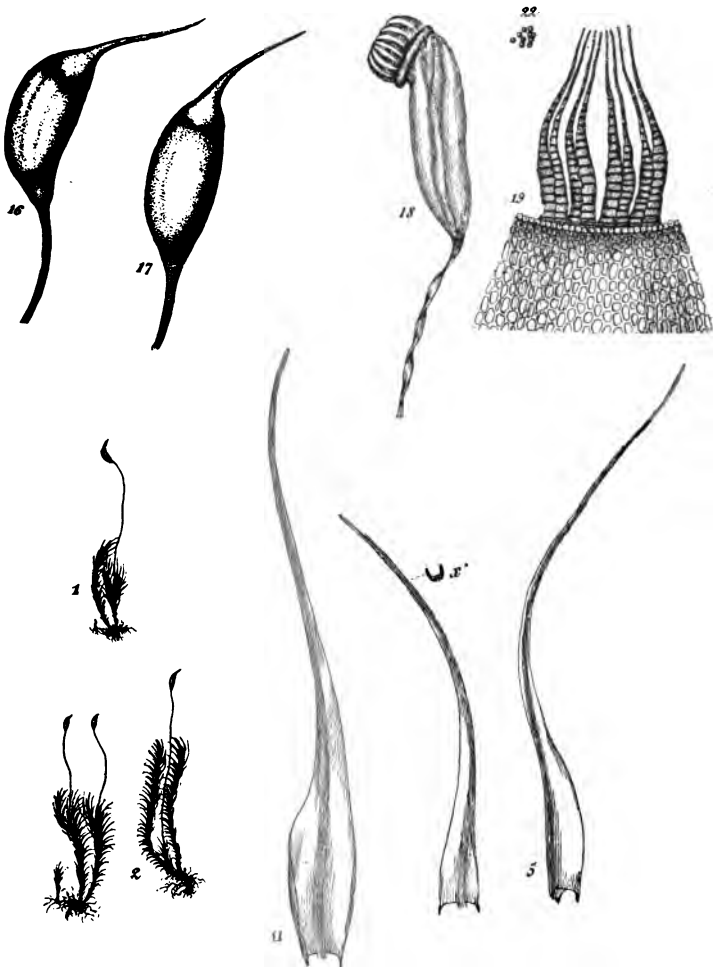

PLATE IX. *Dicranella heteromalla* (L.) Schimp. (From Bry. Eur.) 1 and 2. Plants natural size. 5. Leaves. 11. Perichætial leaf. 16 and 17. Capsules. 18. Dry capsule with mouth oblique. 19. Peristome.

The variety ORTHOCARPA (Hedw.) E. G. B. is a form with erect straight capsules and, as far as I am able to determine, is

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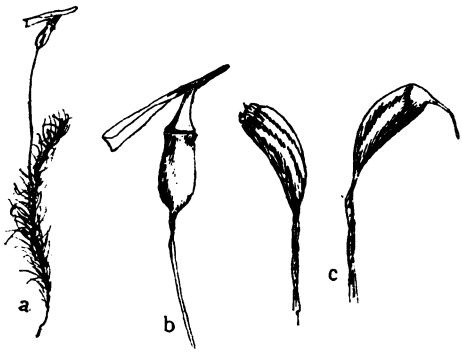

FIGURE 17.

a. Dicranella heteromalla Fitzgeráldii. b. Capsule of the same × 10. *c.* Capsules of different ages.

an inhabitant of elevated inland regions. The capsules, however, appear to become curved and furrowed with age.

Var. FITZGERALDII (R. and C.). I cannot agree with Mrs. Britton, whom I followed in the FIRST EDITION, in making this a synonym of var. *orthocarpa*, as it appears to be a southern and seaboard form, being very abundant about New York city. The capsules are only lightly striate until very old, and the mouth is slightly or not at all oblique. It has been found along Lake Champlain and may occur near the Great Lakes.

In the Bulletin of the Torrey Botanical Club for November, 1895, Mrs. Britton describes and figures a very interesting mountain form with pedicels strongly curved backwards which straighten in drying so as to assume the normal form.

D. CERVICULATA (Hedw.) Schimp. grows in wet places, typically on peat. It appears to be rare. The plants are smaller in every way than the last, the leaves *are less falcate, with a half-sheathing base, often nearly entire; capsule arcuate and gibbous, with a clearly strumose neck.* The spores mature in summer, according to European authors.

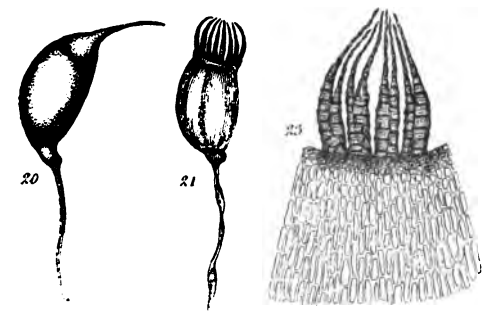

FIGURE 18

Capsules and peristome of *D. cerviculata.* (From Bry. Eur.)

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D. RUFESCENS (Dicks.) Schimp. The *smallest of our species, less than* 1-3 *in. high and very slender.* Plants usually simple, yellowish green or reddish green, turning *more strongly reddish in drying;* leaves small, *pellucid by reason of the large thin-walled cells,* linear-lanceolate, gradually narrowed; costa percurrent but not excurrent; *margin plane,* denticulate above; capsule erect or inclined, *symmetric,* oval, small, urn about 1-32 inch long; *seta and capsule dark red,* seta *twisted to the left;* operculum short-rostrate to apiculate; spores maturing in summer. Not infrequent on bare moist earth, especially on clayey soil.

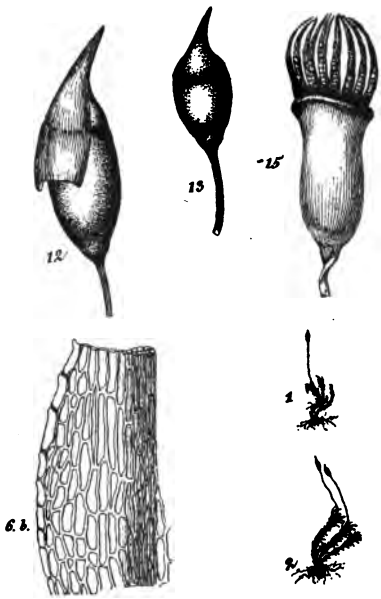

FIGURE 19.

Dicranella rufescens (From Bry. Eur.) 1 and 2. Plants natural size. 6.b. Portion of base of leaf.

The seta of *D. heteromalla* and its varieties is twisted to the left and sometimes becomes very dark, so that forms of var. *Fitzgeraldii* may be mistaken for *D. rufescens* unless one has specimens for comparison. But *rufescens* is very much smaller and more slender, and the leaf-cells are so large and pellucid as to strike one's attention at once.

D. VARIA (Hedw.) Schimp. is a somewhat similar species with a similar habit, but rather less frequent. It is larger, bright or yellowish green, not *reddish,* with short, usually *branching stems.* The leaves are entire with margins *narrowly revolute;* the capsule is larger and *curved,* the seta *twisted to the right;* spores maturing in autumn and winter.

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DICRÀNUM.

The Dicranums have leaves that are narrowly to broadly lanceolate with lower cells rectangular, *angular conspicuously dilated.* The capsules are on straight erect setæ, erect or inclined; teeth red, cleft half-way into two or occasionally three segments. (See Plate II).

The Dicranums of our region are one of the most common and beautiful elements in woodland scenery. They are, for the most part, bright yellow-green and grow in wide thick tufts or mats. The leaves are frequently more or less secund, as though the wind had blown them all in one direction. They are common on the ground, stones, rotten wood, and sometimes they occur on the base and trunks of trees. Most Dicranums mature their spores in autumn, but more observations are needed to give exact dates for each species.

FIGURE 20.

a. Dicranum scopàrium × 1. *á.* Capsule × 5. *b. D. fuscescens* × 1. *b'.* Capsule and calyptra × 5.

There are eighteen or twenty species of Dicranum within our range, but only seven are common enough for treatment here. These seven are best treated in three groups. The first group contains two species with single curved capsules, the Broom Moss and the Fuscous Dicranum.

The second group contains two species with curved clustered capsules and undulate leaves, the Wavy Dicranum and Drummond's Dicranum.

In the third group are three species with single erect capsules, the Flagellate Dicranum, the Fulvous Dicranum, and the Long-leaved Dicranum.

D. SCOPARIUM (L.) Hedw., the Broom Moss. The plants are large, sometimes four inches in height, and grow in rather dense tufts on decayed wood, stones or soil. The lower part of

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the stem is usually covered with a dense felt of radicles. The leaves are falcate-secund but not undulate or crisped. The capsules are curved but are not plicate or striate when dry except in a rather rare variety which has the capsules slightly striate. The spores mature in late summer or autumn.

The Broom Moss gets its name from its resemblance in miniature to a hair broom or counter brush. It is almost as common and widely distributed as the Common Hair-cap, being found in all portions of the northern hemisphere. It is often used by florists to form banks of green in show windows.

D. FUSCESCENS Turn., the Fuscous Dicranum, is a smaller plant yet frequently larger than the figure. The leaves are strongly crisped when dry and the capsules when dry are plainly striate or sulcate. It usually grows on decayed wood in cool moist woods at an elevation of 1000 feet or more, but may be found on soil or bases of trees and occasionally at lower altitudes. The differences between this species and the last are well shown in the figures.

D. UNDULATUM Ehrh., the Wavy Dicranum, is very robust, 3 to 10 inches high, often decumbent at base; growing in loose wide tufts, densely radiculose, bright glossy yellow-green. The *leaves are undulate, with a silky luster,* very long, lanceolate, gradually narrowed, scarcely secund, margin recurved below for 1-3 to 1-2 the length of the leaf, above this strongly serrate to apex. The costa is comparatively narrow, with *two strongly serrate lamellae on the back above.* The alar cells are distinctly marked. *The capsules are clustered* (several setæ from the same perichætium) and the setæ are long and reddish. The capsules are cernuous and arcuate, striate when empty, with spores maturing in late summer.

Our largest and most beautiful species, common in shaded places on soil and stones covered with humus, but not fruiting freely. The only species with which it could possibly be confused is the next.

D. DRUMMONDII Muell., Drummond's Dicranum, is most likely to be mistaken for *D. undulatum,* but it is rather smaller and less glossy; its leaves are less undulate and are secund and *strongly crisped,* not recurved at base below; they are much more slender pointed than in the Wavy Dicranum. The capsules of the two species are very much alike.

The spores mature in summer. It grows on decayed wood in forests in elevated regions, not common.

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PLATE X.

a. Dicranum undulatum × 1. *a'. Leaf* × 8. *b. D. Drummondii* × 1. *b'. Leaf* × 8. *c. D. flagellare* × 2. *c'. Leaf* × 10. *d. Flagella* × 10. *e. D. fulvum* × 2. *é.* Leaf and capsule × 10.

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D. LONGIFOLIUM Ehrh., the Long-leaved Dicranum. This species grows only in rocky elevated regions, sometimes found on the base of trees as well as the surrounding rocks. The leaves are very long and narrowly acuminate so that the *leaf apices look somewhat like hairs,* giving the plant a silky appearance, secund but scarcely crisped when dry with costa more than *½ the width of the leaf at base.* A little above the base *the leaves are suddenly narrowed and in the upper part of the leaf nothing but costa is left for the rest of the length of the leaf.* The capsules are cylindric and smooth; the spores mature in summer.

DICRANODONTIUM LONGIROSTRE is a moss very closely resembling this species when without capsules, but the setæ are very long and curved so that the capsule is sometimes almost pendent.

D. FLAGELLARE Hedw., the Flagellate Dicranum (Pl. X), has slender branchlets (flagella), with minute leaves, which give it its name. It is one of our most common species and by reason of its *crisped leaves* and *narrow costa* is not likely to be confused with any of its group. The flagella are very characteristic when present. It grows on decaying wood and peaty banks in moist shady places everywhere.

D. FULVUM Hook., the Fulvous Dicranum (Pl. X). This is the only other common *Dicranum* with erect capsules. It is *fulvous brown* in color, *always growing on rocks.* The leaves are secund, somewhat crisped when dry, gradually narrowed from a lanceolate base to an almost linear apex; margin serrate in the upper 1-5 to 1-4. *The costa is at least 1-3 the width of the leaves at base,* somewhat excurrent, toothed at back, with the apices much more slenderly tubulose than in *D. flagellare.*

The Flagellate and Fulvous Dicranums need never be confused, for the former grows on rotten wood or peaty banks, while the latter always grows on rocks.

The Fulvous Dicranum is distinguished from the Long-leaved by its color, its shorter leaves, and by growing at lower altitudes in more shaded, less exposed localities.

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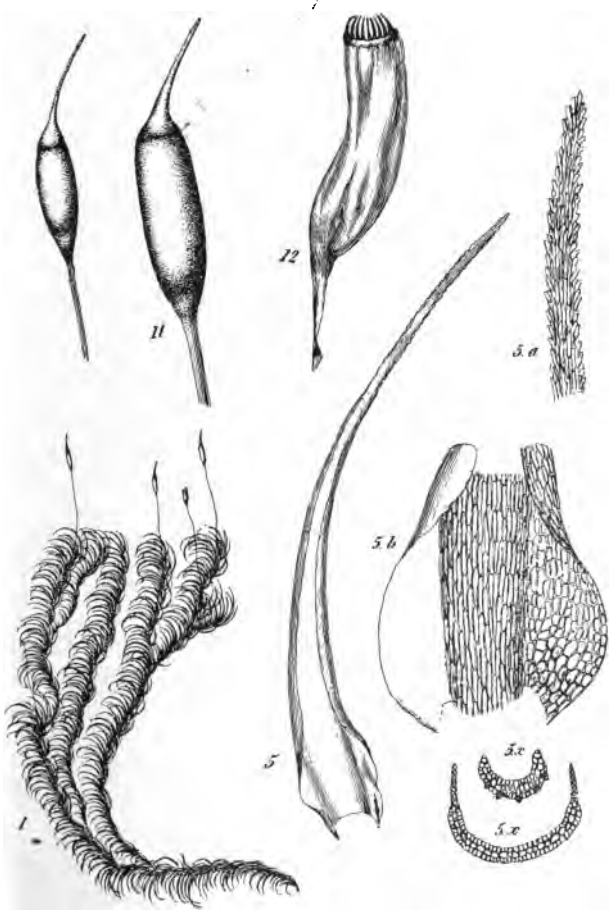

PLATE XI. *Dicranum longifolium* (From Bry. Eur.)
1. Plant natural size. 5. Leaf. 5.a. and 5.b. Leaf apex and base. 5x. Cross sections of leaf. 11 and 12. Capsules.

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LEUCOBRYUM.

L. GLAUCUM (L.) Schimp., the White Moss. Any one accustomed to walk in the woods must have noticed the grayish-white tufts of the White Moss, looking like gigantic pincushions.

This moss does not fruit freely, but by searching in moist woods the sporophyte can usually be found without a great deal of trouble. It matures from September to June.

FIG. 21 *Leucobryum glaucum* × 1.

The White Moss prefers moist or even swampy woods, but is often found in drier situations. The plants grow densely packed together, those in the center continually elongating and new plants being added around the edges of the tuft. The White Moss resembles the Peat Mosses in color, and the cushion-like tufts take up and retain water in the same sponge-like way.

Braithwaite states that this species often produces on the upper leaves of the female plants, minute tufts of "radicular tomentum" with young plants which fall off and serve to reproduce the plant, which produces spores rather infrequently. The amount of rainfall has apparently some influence on the spore production of this species, for I have noticed that it produces spores with unusual abundance after an especially wet summer.

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FAMILY 8. GRIMMIACEAE. The Grimmia Family.

FOR a long time most members of this family seemed too difficult to study with a hand-lens, but nearly all the more common forms can be distinguished if one knows what to look for as characteristic of each species. The plants grow in tufts or mats and almost *always grow on rocks.* They are dark-brown or blackish, often green at the surface of the tufts where the young growing portion of the plant is. In many plants the leaves end in a whitish hairlike point that gives the plants a gray or hoary appearance. It is of great importance in determining the species to find out whether the margins of the leaves are plane or recurved when dry, and this can readily be made out by a careful examination with a hand-lens in a strong light. In appearance the plants of this family are much like those of the Orthotrichum Family, but in the Grimmia Family the calyptra is never hairy; the capsules are smooth when dry or at most irregularly wrinkled; the peristome single with the 16 teeth sometimes spreading but never reflexed, often forked, but never united in pairs; leaves never crisped (except Ptychomitrium). In the Orthotrichum Family the calyptra is often hairy, the capsules are nearly always deeply plicate when dry with 8 or 16 regular folds; the peristome is double, though the segments are often very narrow; the 16 teeth are often united in pairs, and nearly always strongly reflexed when dry, sometimes bending so far back as to touch the capsule wall; and the leaves are often crisped, although not so in the genus Orthotrichum. With few exceptions the plants of the Orthotrichum Family grow on the trunks of living trees.

Two species (*Orthotrichum anomalum* and *Ulota Americana*) of the Orthotrichum Family grow on rocks, both have hairy calyptras and a double peristome. Some species in both families lack the peristome. Some species of Andreaea when sterile are hard to distinguish from this family, but nearly all are subalpine. Farther distinctions are found under Andreaea.

KEY TO THE GENERA.

Leaves crisped, without whitish tips, costate; capsules long exserted.. ..... *Ptychomitrium*

Leaves not crisped, with whitish tips and no costa; capsules immersed ..... *Hedwigia.*

Leaves not crisped, costate, whitish tips present in some forms, absent in others; capsules immersed or exserted..... ..... *Grimmia* and *Rhacomitrium*

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HEDWIGIA

is named for Hedwig, one of the best bryologists of the eighteenth century.

H. ALBICANS (Web.) Lindb. (*H. ciliata* Ehrh.) is our only species. It is common on boulders, ledges, stone walls, and dry exposed places. The plants vary a great deal in size, but in general have much longer stems and branches than their relatives, besides being much the most common of all the family.

The lower part of the plant is brown or black, the upper green, with a tinge of gray due to the colorless tips of the leaves. The perichætial leaves are ciliate along their upper margins as shown in the cut. There is no costa in any of the leaves, and no peristome, both of which characters are rare in this family. The capsules are entirely concealed in the longer more slender perichætial leaves, and the

FIGURE 22.

4*a* and 4*á*. Apices of leaves of ***Hedwigia albicans.*** 10*a*. Apex of perichætial leaf. (From Bry. Eur.).

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only indication of their presence is a slight enlargement of the ends of some of the branches. The capsules are almost spherical, with a clear-cut lid and no peristome; they mature in spring.

An attempt has been made to illustrate the remarkable trans-

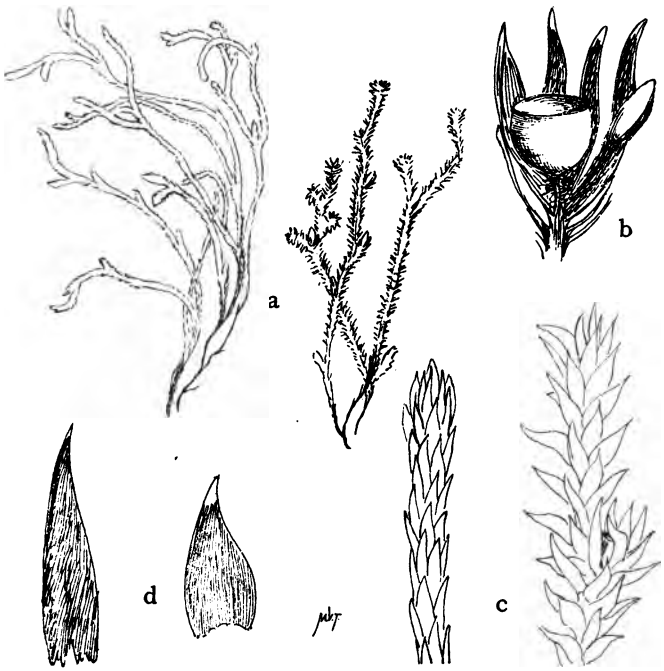

FIGURE 23. *Hedwigia albicans*, a, × 1, dry and wet. b, Capsule with a portion of the perichætial leaves removed × 10. c, Branches, dry and wet × 5. d, Leaves × 10.

formation that these plants undergo when moistened, but no drawing can do justice to the magic of the change.

PTYCHOMÍTRIUM.

This genus is rare in most parts of our range and only one species is likely to be found.

P. INCURVUM (Schwaegr.) Sulliv. The plants of this species are about ¼ inch in height (½ inch with fruit) and

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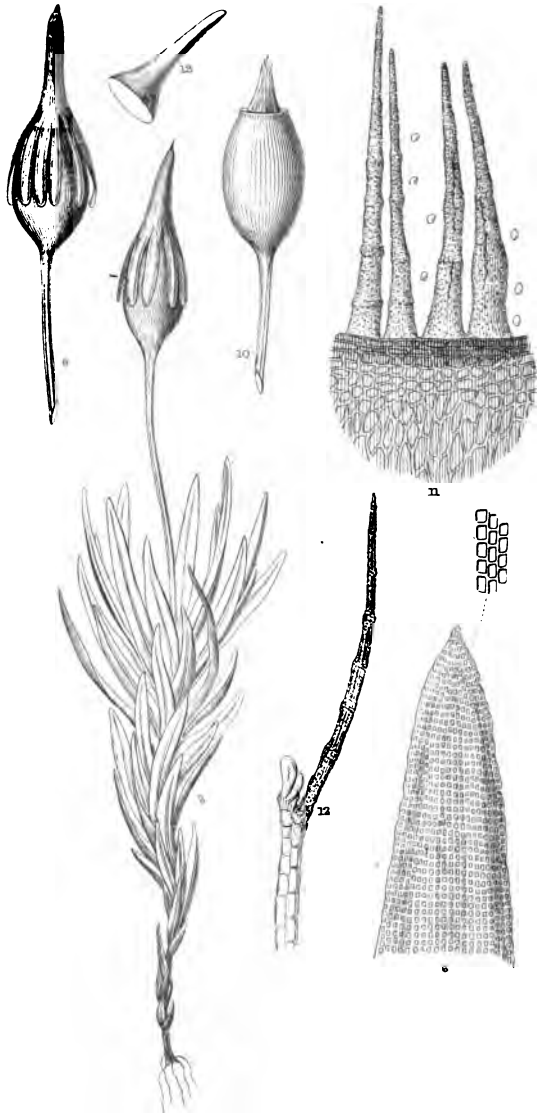

PLATE XII. Explanation on next page.

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grow on granitic rocks from Connecticut southwards. The leaves slender. The spores mature in winter or early spring. are crisped and without whitish hair points; the calyptra is mitrate, plicate and without hairs; the operculum is long beaked; the capsule nearly smooth when dry, and the peristome teeth are

The crispate leaves remind one very strongly of *Ulota* and indeed it is most likely to be mistaken for a member of that genus so far as general appearance goes, but its habitat on granitic rocks and its long beaked operculum, scarcely striate capsule and single peristome of slender teeth will easily differentiate it.

GRIMMIA AND RHACOMITRIUM

are so much alike, except in microscopic characters, that it will be much more convenient to treat them together. The family description will answer for these genera.

KEY TO THE SPECIES.

1. Capsule exserted or at least shorter than the seta.....2.
   Capsules immersed, longer than the seta.....5.
2. Seta strongly curved; leaf margins not reflexed.....*G. Olneyi.*
   Seta straight; leaf margins recurved.....3.
3. Stems usually elongated and slender, bearing numerous short clustered obtuse lateral branchlets; leaves lanceolate, acute; subalpine or growing on exposed rocks.....4.
   Stems stout without short lateral branchlets; leaves lingulate broadly obtuse; growing near waterfalls and on wet rocks in cool or elevated regions.....*R. aciculare.*
4. Leaves without whitish hair tips.....*R. fasciculare.*
   Whitish hair tips present on some of the leaves.....*R. microcarpum.*
5. Plants with conspicuous whitish leaf tips, columella not attached to operculum.....*G. Pennsylvanica.*
   Whitish leaf tips absent or inconspicuous; operculum falling with columella attached.....*G. apocarpa.*

GRIMMIA.

G. APOCARPA (L.) Hedw., the Common Grimmia, is our most common member of the family next to Hedwigia, for which it might possibly be mistaken, but it is smaller, with whitish leaf tips scarcely visible, often lacking on many of the leaves, with leaves plainly costate and with margins strongly recurved. The peristome is well developed and plainly visible with a lens. The most distinctive character is the falling of the columella attached to the operculum. This character is best ascertained by remov-

PLATE XII. *Ptychomitrium incurvum.* (From Sulliv. "Icones.") 2. Plant, highly magnified. 6. Apex of leaf. 12. Side view of annulus and peristome tooth. 6 and 12 require a compound microscope.

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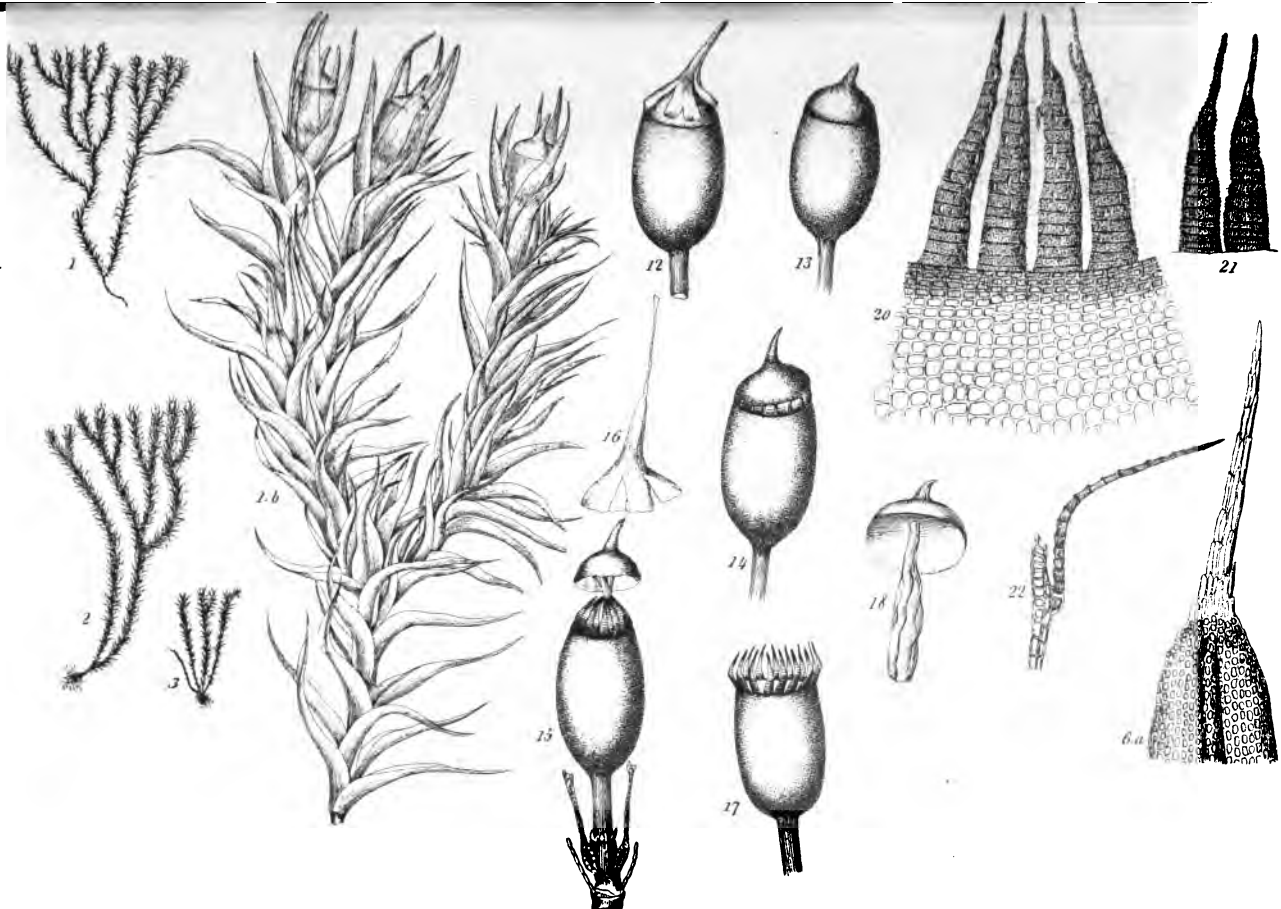

PLATE XIII. Explanation on the next page.

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ing the lid from a ripe capsule with dissecting needles and examining with a high power lens. There are other species with this peculiarity, but they are rare or local.

G. PENNSYLVANICA Schwaegr., the Pennsylvania Grimmia, seems to be our most common species next to *apocarpa,* but in the northern portion of our range it seems seldom to fruit and is apparently little collected. It is a *large coarse* dark green moss from ½ inch to 1 inch high, slightly hoary at the ends of the stems; leaves lanceolate, *appearing very dark and opaque in the upper part, margin strongly recurved,* hair-point short and rough, cells at extreme *base elongated-rectangular* and hyaline or yellowish; next above these the cells are short rectangular, as shown in the figure. The spores mature in late autumn, but operculate capsules may be found in April.

FIGURE 24. *Grimmia Olneyi* (From Sulliv. "Icones"). 1. Plants natural size. 6. Leaf apex. 12. Capsule and seta.

G. OLNEYI Sulliv., Olney's Grimmia, grows in dark green tufts, blackish below, more compact and *finer grained* than *apocarpa;* stems often nearly denuded of leaves below, about 1 inch high; leaves lanceolate from an ovate base, the upper *ending in a long rough hyaline hair, margins not at all reflexed;* capsule exserted on a *curved seta;* operculum beaked; spores maturing in April. On rocks, not rare in the lowlands of the central portion

PLATE XIII. *Grimmia apocarpa* (From Bry. Eur.).

1, 2, 3 and 4. Plants natural size. Fig. 6*a*. Apex of upper leaf. Fig. 18. Operculum with the attached columella. The other figures are self-explanatory.

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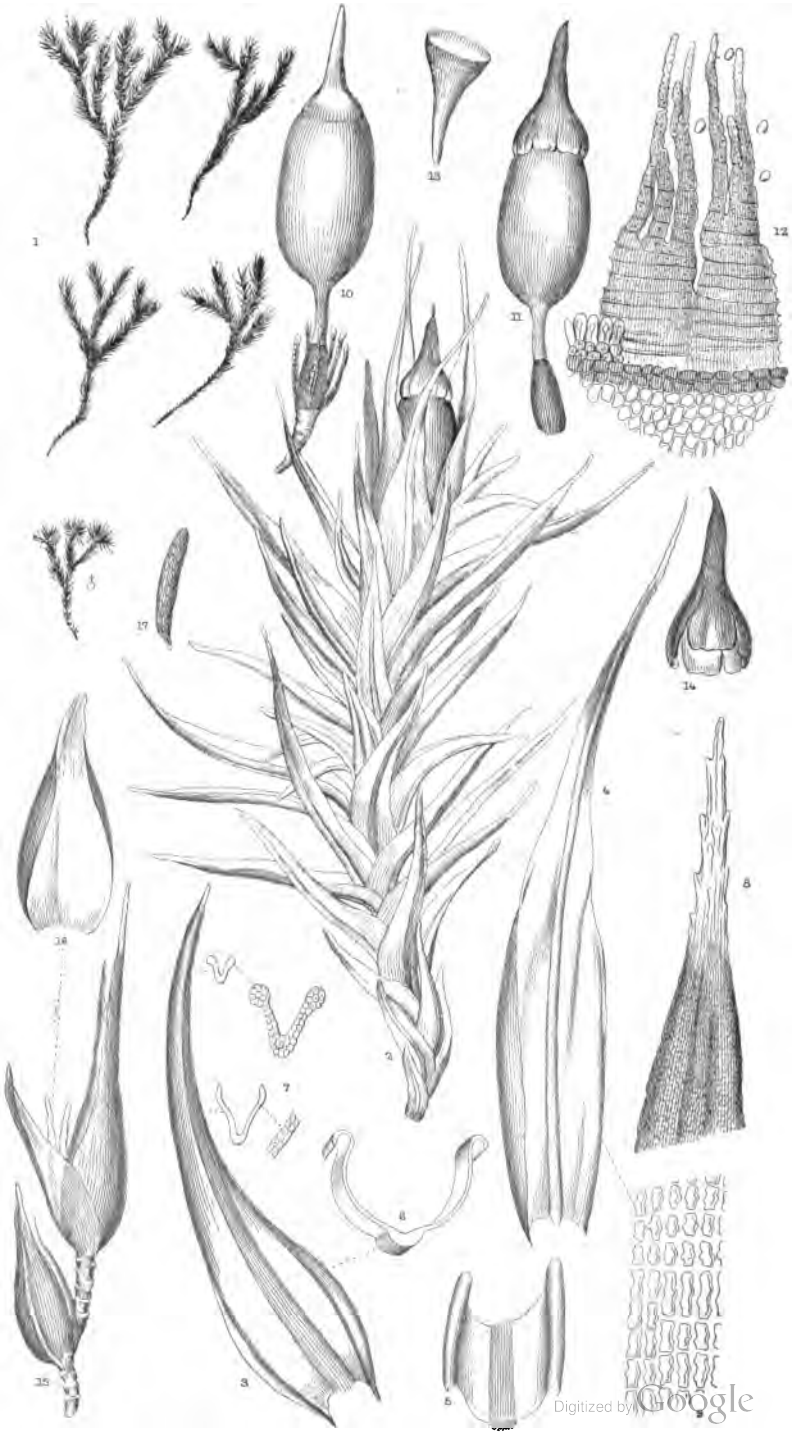

PLATE XIV. Explanation on next page.

of our range especially along rivers, extending north to southern Vermont. This is our only species with curved seta, and even in this a portion of the setæ seem almost erect. In the dried specimens the capsule appears more fully exserted than is indicated in the figure. This is the only one of the species here treated that has plane leaf-margins.

RHACOMITRIUM.

R. ACICULARE (L.) Brid. is one of our common mosses occurring around waterfalls and on wet rocks in cool and in elevated situations. Plants large, 1 to 3 inches long, and very stout; the broad leaves broadly obtuse, entire or denticulate at apex with small distant teeth, characterize this species so distinctly that no further description is needed, except that given by the plate. The leaf-characters are so distinct that this species is easily recognized with a hand-lens. The spores mature in spring, but well-developed capsules are found in autumn. In this species as well as in most others of the genus nearly an entire year seems to be needed for the complete development of the sporophyte.

R. FASCICULARE (Schrad.) Brid. grows in rather close flat patches, yellowish green above, black or brownish below, bearing *very numerous short obtuse lateral branchlets* (see Pl. XVI); leaves *lanceolate, nearly or quite obtuse, without hyaline point;* costa faint, vanishing below the apex; peristome teeth divided to the base, spores maturing in spring. Most likely to be confused with *microcarpum,* but easily distinguished by the total absence of hair-points. Common in alpine or subalpine regions, but not likely to be met with elsewhere.

R. MICROCARPUM (Schrad.) Brid. resembles the last in general appearance, but with leaves shorter and having a *stronger percurrent costa* and *hyaline-tipped leaves* (in the perichætial leaves the costa ceases below the apex and the apex is sometimes obtuse without hyaline tips, making a puzzling combination), hyaline apex of leaves denticulate; capsule smaller and

PLATE XIV. *Grimmia Pennsylvanica* (From Sulliv. "Icones").
1. Plants natural size. Figs. 15, 16 and 17. Antheridial buds, perigonial leaf, and antheridium respectively. The other figures are self-explanatory. A number of the figures require a compound microscope for their demonstration.

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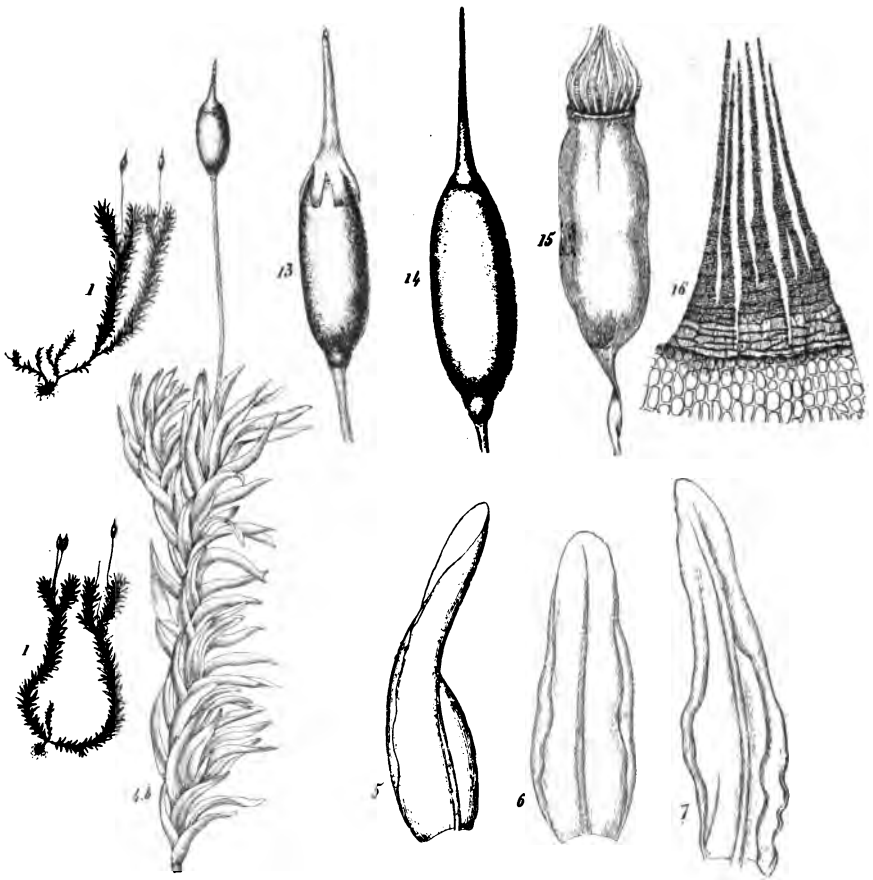

PLATE XV. *Rhacomitrium aciculare* (From Bry. Eur.).
1. Plants natural size. 5, 6, 7. Leaves.

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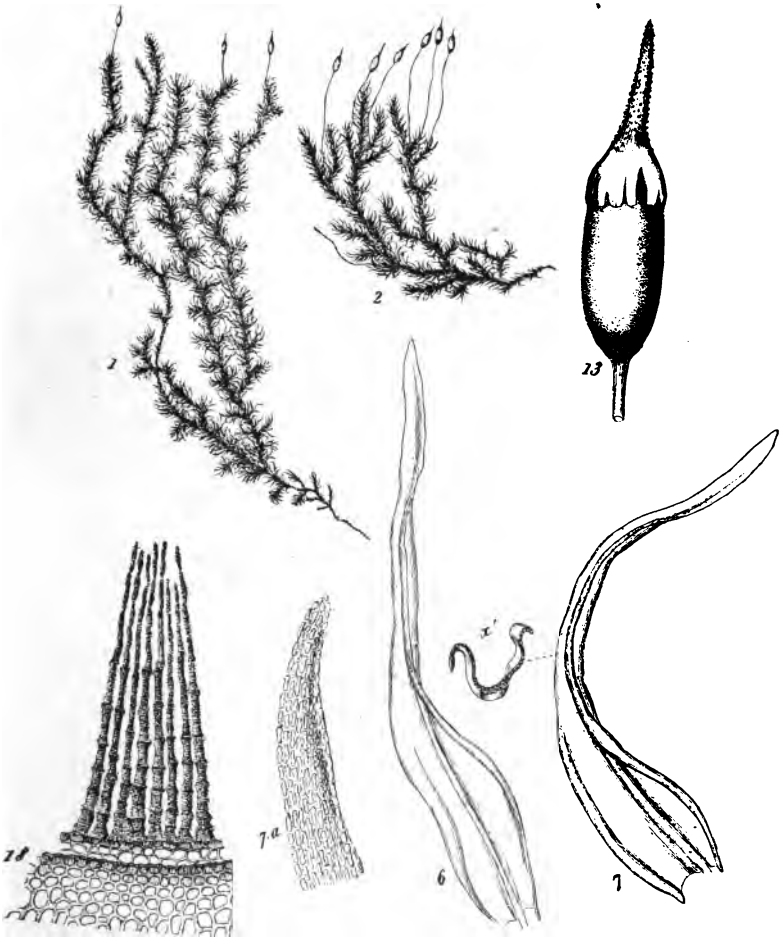

PLATE XVI. *Rhacomitrium fasciculare.* (From Bry. Eur.).
1. Plant natural size, showing characteristic method of branching. 7.a. Apex of leaf. The other figures are self-explanatory.

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lighter-colored than in the last; spores maturing in spring. Our most common species after *aciculare,* growing on exposed rocks on hills throughout our range, but apparently somewhat local. The form with obtuse perichætial leaves which seems common in the Franconia Mountains is likely to be mistaken for *fasciculare,* unless the lower leaves be examined.

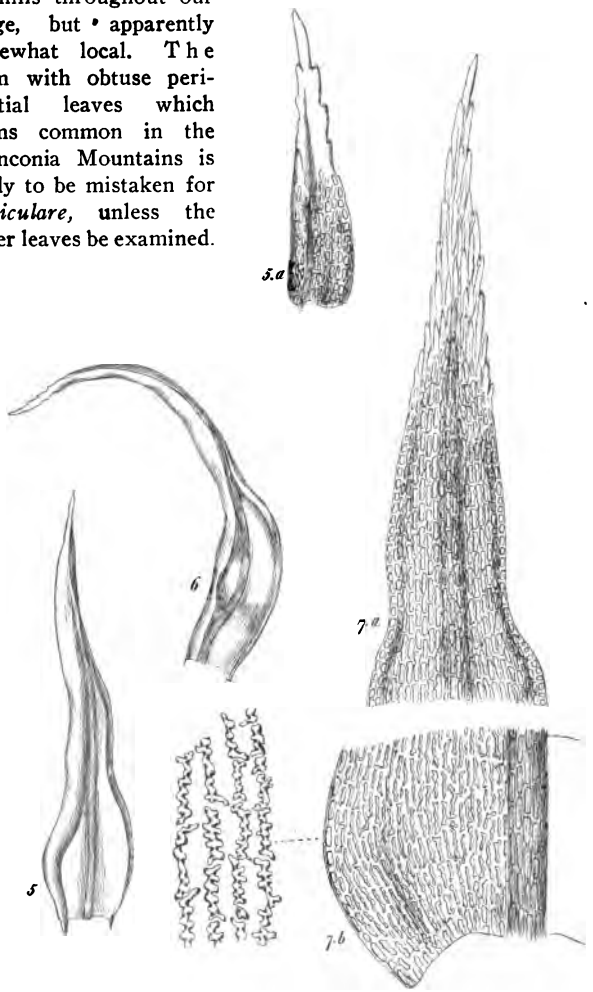

FIGURE 25. *Rhacomitrium microcarpum* (From Bry. Eur.). Leaves and leaf-structure.

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FAMILY 9. TORTULACEAE. Tortula Family.

THE family name is particularly appropriate, as not only are the leaves twisted (often strongly crisped) when dry in nearly all the species, but the peristome also is strongly twisted in a large number of the genera. The family is a large one with a very great range of variation which is partly due to the degeneracy of several of its members. The species here treated all grow on soil or crumbling moist rocks and cliffs. Nearly all are short stemmed with radicles present at base only. The leaves in nearly every case have the basal 1-3 to 1-2 made up of thin-walled hyaline or slightly colored cells, while the upper portion is made up of minute thick-walled cells so that it appears nearly opaque. The costa is nearly always strong and often excurrent. Astomum, which is treated with Pleuridium, does not open its capsules by a lid, and Pottia, which is treated with Physcomitrium, and Gymnostomum have no peristome, but the great majority of the species have a well developed peristome which may consist of 16 straight, slender, more or less divided teeth, or in many cases of 32 fine hairlike teeth spirally twisted in several turns (see Plate I, Figs. 6, 7, and 8.) The capsules are on rather long straight setæ and are usually erect and cylindrical or nearly so.

KEY TO THE GENERA.

1. Leaves tapering gradually from the base to the acute apex.....3.
   Leaves increasing in width from the base upwards, or at least not narrowed until near apex, broad in outline and rounded at apex except for the costa, which often extends out into a long white hair.....2.
2. Peristome of 32 filiform strongly twisted teeth which arise from a high basal membrane (basal membrane short in *T. muralis*).....*Tortula*
   Teeth 16, short, not twisted.....*Desmatodon.*
3. Peristome lacking. Plants common on wet ledges and cliffs where lime is present.....*Gymnostomum.*
   Peristome present, operculum falling as soon as detached.....4.
4. Leaves curled to slightly crisped, with margins revolute; basal part of leaf usually somewhat colored; peristome twisted....*Barbula.*
   Leaves strongly crisped when dry with margins plane or rolled inwards and base usually hyaline.....5.
5. Peristome of 16 short teeth; plants small.....*Weisia.*
   Peristome of 32 slender twisted teeth; plants large for the family .....*Tortella.*

GYMNOSTOMUM.

If you can find a wet cliff with some lime in its composition

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you will be almost sure to find a portion of it covered with the dense mats of Gymnostomum which we might call, after the manner of a well known Flora, the Toothless Twisted Moss, as the generic name means, lacking a peristome. The dense mats usually produce an abundance of small ovoid capsules which mature in autumn. The leaves are really less twisted than any other genus of the family, hardly enough to be noticeable.

G. CURVIROSTRE (Ehrh.) Hedw. This is apparently our most common species as well as our largest. The plants sometimes reach a length of 4 inches. The leaves are scarcely twisted when dry, narrowly lanceolate, acute, with *one margin,* at least, *recurved.* The seta is usually longer than in the other species; *capsule dark red-brown, glossy, thick-walled,* widest at mouth when dry and empty. The *operculum remains attached to the columella after separating from the urn* and is thus attached for some time. The spores mature in late summer or autumn.

This species and the next are very closely related and are often confused. If collected in autumn or winter this species is readily distinguished by reason of the fact that the operculum remains attached to the columella after dehiscence. I have found opercula as late as May or June when the young sporophytes were beginning to appear. When moistened the capsule-walls and the operculum swell so as to again close the capsule and thus do the work ordinarily done by the peristome.

G. RUPESTRE Schleich. is distinguished from the preceding by the *broader-pointed, plane-margined leaves,* the shorter seta, and the *thin-walled, yellowish-brown capsule* and by the *completely* dehiscent operculum. Very much less frequent than G. curvirostre.

WEISIA.

The Weisias are small mosses growing in tufts or mats on soil, especially rather dry sandy soil with our species, freely branching; the upper leaves are usually much larger than the lower, erect-spreading, strongly crispate when dry, elongated-lanceolate with the costa usually excurrent into a short point; capsule well exserted on a seta of moderate length, usually erect and symmetric, ovoid, plicate when dry and empty.

W. VIRIDULA (L.) Hedw. is a species common in rather dry

PLATE XVII. *Gymnostomum curvirostre* (From Bry. Eur.).
1 and 2. Plants natural size. 12. Section of capsule.

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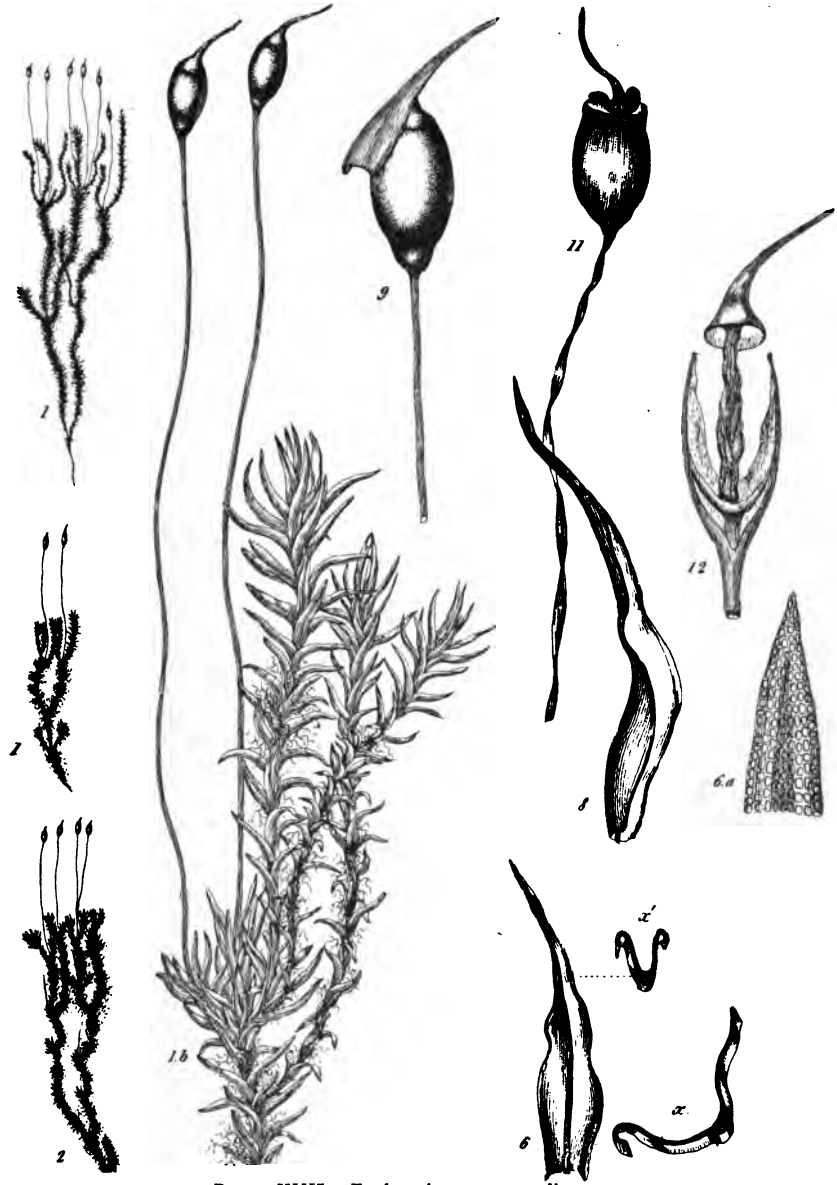

PLATE XVII. Explanation on preceding page.

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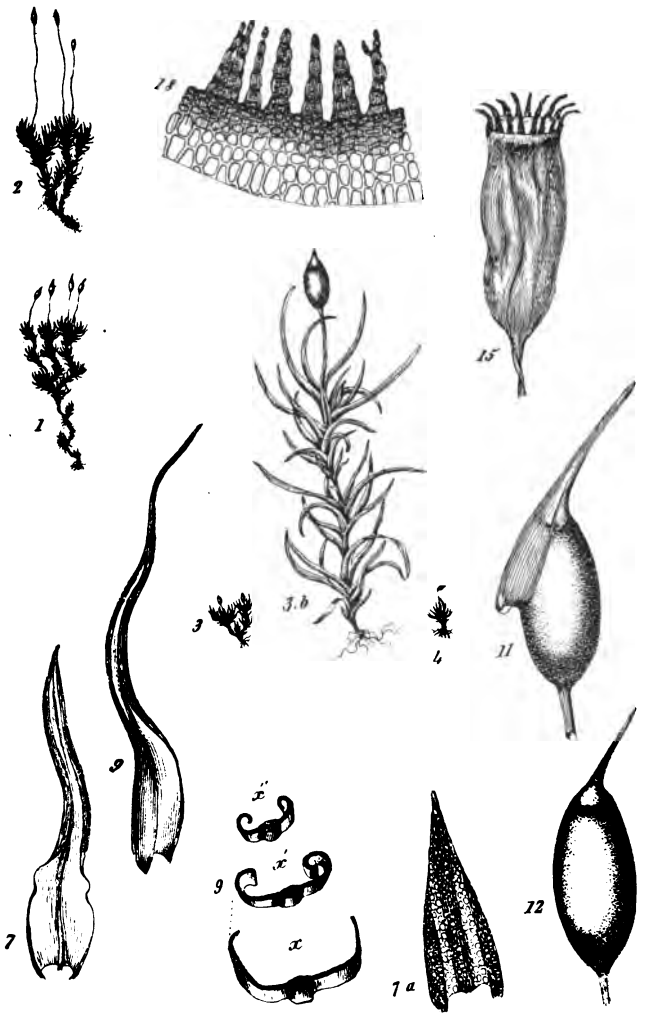

PLATE XVIII. *Weisia viridula* (From Bry. Eur.). 1, 2, 3, and 4. Plants natural size. The other figures are self-explanatory.

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soil and occasionally growing in more moist situations. It is exceedingly variable in its peristome and its size. Our plants are mainly of the smaller size figured in the plate, but the capsules are nearly always erect. It may usually be distinguished from *Astomum* when sterile by its larger size and longer leaves. The margins of the leaves are so strongly inrolled above as to make them appear almost tubular. The capsules do not apparently become wrinkled as shown in the plate until they have reached a considerable age. The spores mature in spring. In Californian forms the peristome is almost entirely lacking.

BARBULA.

The leaves of this genus are lanceolate from a broader base (except *B. unguiculata*) and are somewhat contorted when dry but scarcely crispate, margins revolute. The costa is percurrent or barely excurrent. The capsules are nearly cylindric and the peristomes strongly twisted. Tortella and Tortula are likely to be confused with Barbula, but in Tortella the leaves are strongly crisped when dry and the transparent cells at the base run up the margin so that the boundary line between the transparent and opaque areas is in the shape of the letter V. In all our species of Tortula here described the costa is long excurrent into a hair point.

B. UNGUICULATA (Huds.) Hedw., the Common Barbula, is our most common and most variable Barbula. The plants are green to dirty green, ¼-inch high; leaves erect-spreading or slightly recurved when moist, spirally twisted when dry, lingulate to oblong-lanceolate, obtuse. The costa is excurrent into a short round mucro; margin recurved below, but plane above. The perichætial leaves are longer and more acute. The seta is red-brown; the capsule oblong or cylindric, usually symmetric, with beaked lid. The peristome teeth are long and slender, spirally twisted in two turns. The spores mature from late autumn to early spring. On damp earth, walls, and stones. Exceedingly variable, especially in leaf forms, which may become lance-linear, and even acute in the case of the perichætial leaves. It might be confused with *Tortella caespitosa,* but the leaves are shorter than in that species; the margins are recurved and the hyaline basal cells do not run up the margin. In general the plants are much darker colored.

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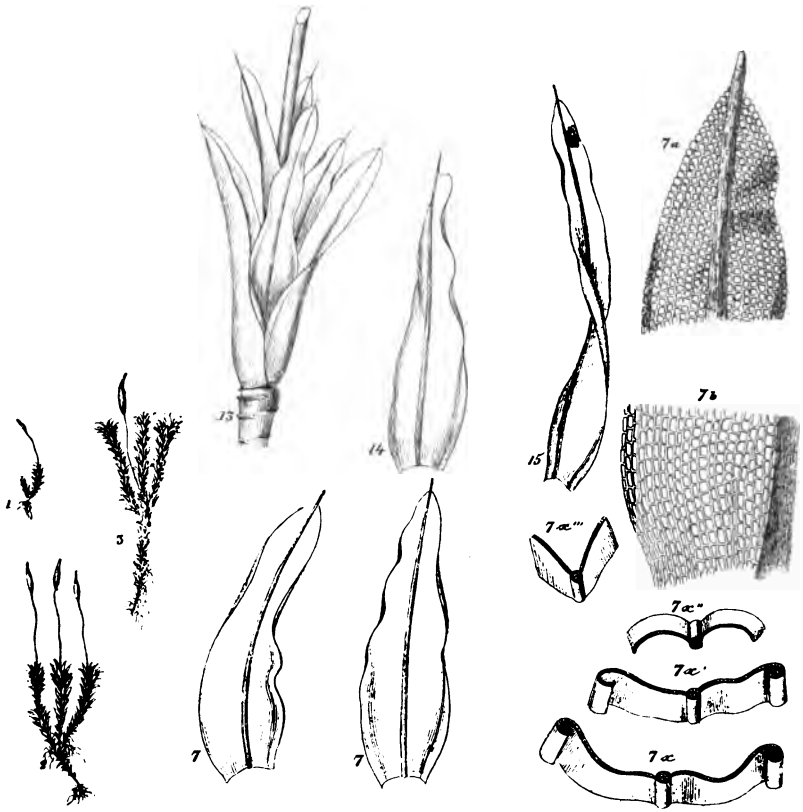

PLATE XIX. *Barbula unguiculata* (From Bry. Eur.). 1, 2, 3. Plants natural size.

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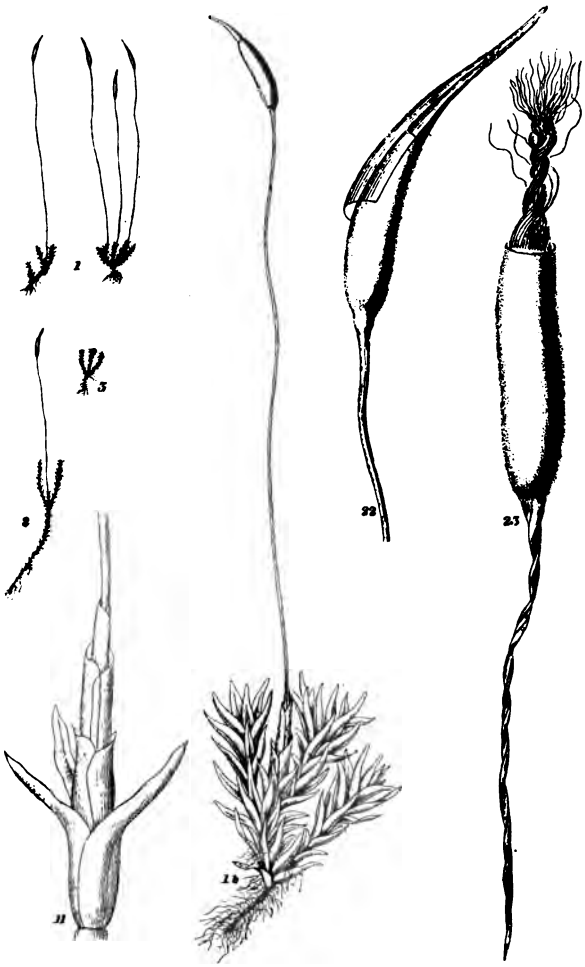

PLATE XX. *Barbula convoluta* (From Bry. Eur.).

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B. CONVOLUTA Hedw., the Sheathing Barbula, is next to the preceding our most common Barbula. The plants are slender, less than ¼ an inch high, densely cæspitose, yellowish green. The leaves are erect-spreading when moist, crisped when dry, oblong-lanceolate to lingulate, obtuse to obtusely acute. The costa ends in or below the apex, very rarely excurrent into a minute point. The margin of the leaf is said to be slightly recurved at base, *but this character is very hard to demonstrate. The perichaetial leaves are long-sheathing, convolute, inner without costa.* The seta is ¼ to 1 inch long, slender, *straw colored or becoming reddish with age,* and the peristome several times twisted. The spores mature in spring. On soil, especially in limestone regions, in rather dry places.

At first sight this species reminds one of *Ceratodon,* but the longer operculum, yellowish seta, and convolute perichætial leaves easily distinguish it, even with a hand-lens.

TORTÉLLA.

Much like Barbula except for the differences enumerated under that genus. The plants are usually larger with longer, plane-margined leaves, and grow in denser, often densely radiculose tufts.

T. CAESPITOSA (Schwaegr.) Limpr. strongly resemble *Barbula unguiculata,* but the leaves are much longer, with plane margins and hyaline cells running up the margin. It is common on roots of trees and on soil in woods. The spores mature in spring.

T. TORTUOSA (L.) Limpr. The plants of this species are 1-3 inches in height, densely radiculose with red-brown filaments, stout, *growing in dense rounded tufts,* pale or yellowish green above, light brown below. The leaves are crowded, very long (¼ inch), *linear-lanceolate,* tapering gradually to the *slenderly acute apex,* spreading and flexuose when moist, very strongly crisped, and often spirally contorted when dry. The *costa is excurrent into a short acute point,* hyaline area at base large and extending obliquely far up the margin. The seta is ½ to 1 inch long, *red below, paler above.* The spores mature in late spring. Common on rocks, especially limestone, perhaps the most common species of the family except *Weisia viridula,* but fruiting

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PLATE XXI. *Tortella tortuosa* (From Bry. Eur.). 1 and 2. Plants natural size.

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rather infrequently. This species is of almost world-wide distribution.

The large size of the plants and the *long-linear* or *lance-linear* slenderly acuminate leaves, much crisped when dry, make the species easy of recognition.

TÓRTULA. The Twisted Mosses.

The Twisted Mosses are large for the family and are easily recognized by the tongue-shaped leaves with long excurrent, hairlike costa, and long twisted peristome. To make out these characters satisfactorily it is best to mount the parts on a microscope slide. In all the species except *T. muralis* the basal part of the peristome is tubular.

The Twisted Mosses are not common, and the person who gets good fruiting material has cause for congratulation.

T. MURALIS (L.) Hedw. The botanical name of this plant is

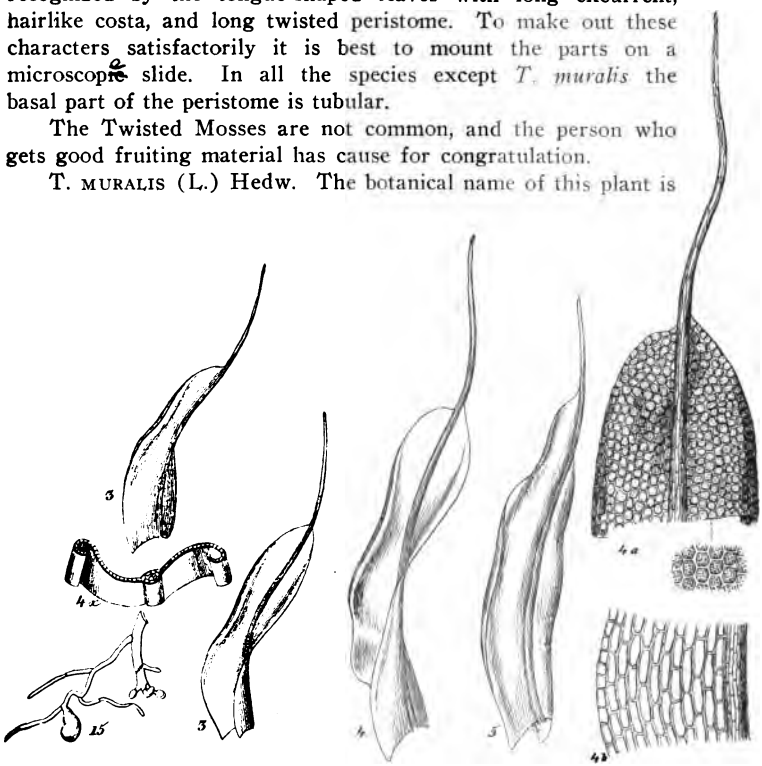

FIGURE 26. Leaves, leaf sections, and radicles of *Tortula muralis*. (From Bry. Eur.).

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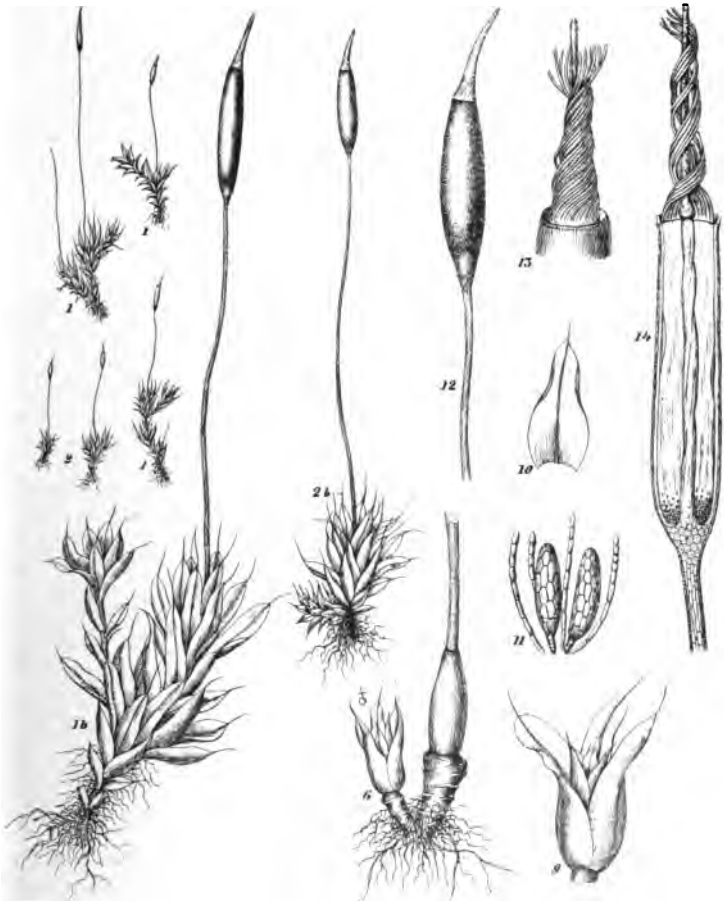

PLATE XXII. *Tortula muralis* (From Bry. Eur.).
1 and 2. Plants natural size. 9, 10 and 11. Antheridial bud, perigonial leaf, and antheridia respectively. The other figures are self-explanatory.

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typical of the compactness and convenience of scientific terms. It means the Twisted Moss that grows on walls. And it is on walls and stones, especially those that contain lime, that one should look for this moss. It grows abundantly on the mortar of the wall at the upper side of the Richmond trolley line on Staten Island at the point opposite the New Dorp Railroad station.

It typically grows in small dense cushions, short, averaging about ½ inch high, dull or bright green; leaves twisted and curled when dry, oblong-lanceolate below to elongated-lingulate above; margin closely revolute, causing the leaves to appear margined; costa excurrent into a very long smooth hyaline hair which is usually one-half the length of the leaf; capsule broadly cylindric, on a red-brown seta which is orange when young. Distinct in fruiting forms by the narrow basal membrane. The combination of papillose leaf-cells, smooth hair-point and revolute margin will serve to distinguish from everything except possibly *Desmatodon plinthobius*.

T. RURALIS (L.) Ehrh. is larger than the preceding, 1 to 2½ inches high, branched, bright green above, reddish-brown below; leaves *recurved-squarrose above* when moist, when dry appressed and somewhat twisted, oblong to oblong-spatulate, *rounded or notched at apex;* perichætial leaves acute; *costa excurrent into a very long and very rough hair which is hyaline above and often colored at base;* margin reflexed almost to apex. *The capsule is cylindric, long,* with lid half as long as capsule, basal membrane constituting one-half the long peristome; spores maturing in spring. On ground in woods and on stones. Common on the Pacific coast but infrequent eastward. Variable but distinguished by the italicized characters. The hair-point is so very strongly toothed that the roughness can be seen with a hand-lens. The western forms of this species grade into the form known as *T. ruraliformis* (Besch.) Dixon, a more robust plant with the leaves acuminate; the lamina at the base of the hair-point scarious and running up along the base of the hair.

DESMATODON PLINTHOBIUS Sulliv. & Lesq. is a small moss about ¼ inch in height, or less, which is common in the Central States. The leaves are smaller than those of *Tortula muralis* and the hair point is often as long as the leaf, but otherwise so much like that species that confusion is likely to result. The small size of the plant and the short untwisted peristome will serve to identify it.

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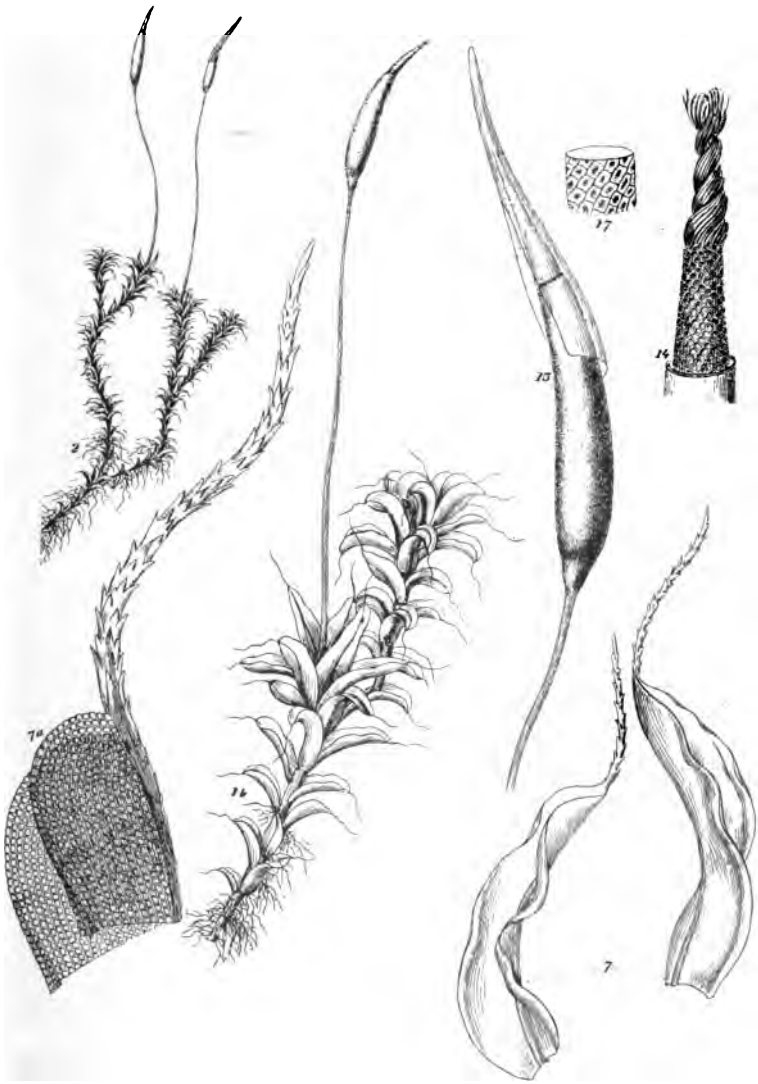

PLATE XXIII. *Tortula ruralis* (From Bry. Eur.). 2. Plant natural size. The other figures are self-explanatory.

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FAMILY 10. ENCALYPTACEAE. Extinguisher Mosses.

WE have but one genus of the Extinguisher Mosses, which as a whole are closely related to the Twisted Mosses in habit and leaf structure. The leaves are large and tongue-shaped and are crisped when dry as in Tortula, but the costa is little or not at all excurrent. When in perfect fruit there is no possibility of mistaking the Extinguisher Mosses, as the large extinguisher-like calyptra extends well below the capsule as shown in figure 27.

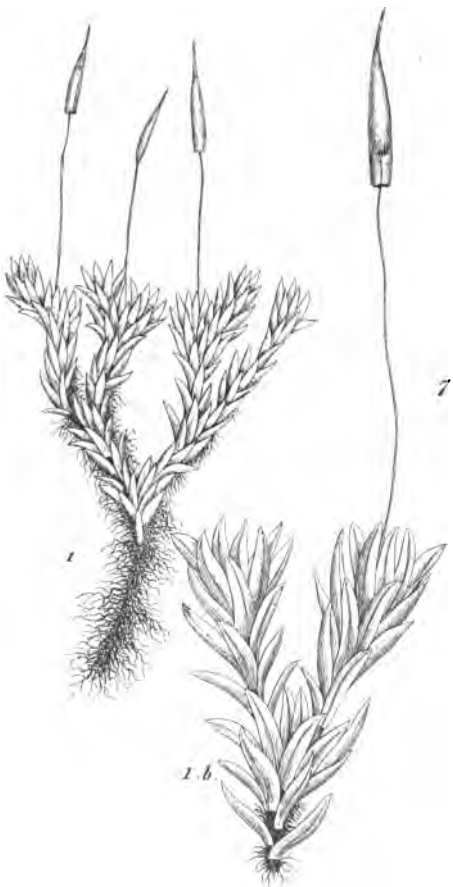

FIGURE 27. *Encalypta streptocarpa*. (From Bry. Eur.). 1. Plant natural size. 1b. Plant enlarged.

ENCALYPTA.

E. STREPTOCARPA Hedw., the Common Extinguisher Moss, is very common on limestone, but rarely or never fruits in this country. The plants are very large, 1 to 2½ inches in height, and many of the large (about ¼ inch in length) coarse leaves are strongly incurved at apex and sub-

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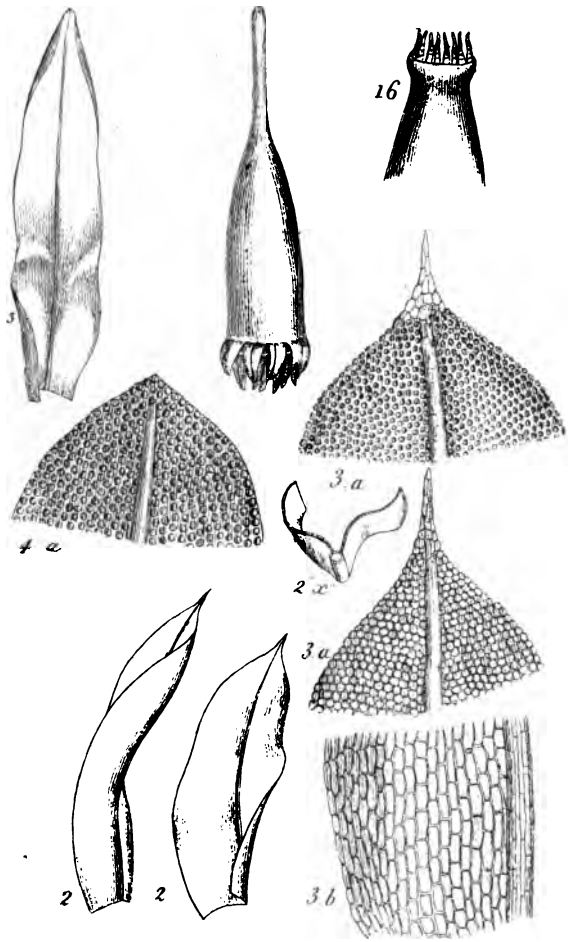

PLATE XXIV. (From Bry. Eur.). 3 and 4a. Leaf and flattened leaf-apex of *Encalypta streptocarpa*. The rest of the figures are of *E. ciliata*. 16. Mouth of capsule with peristome. At the left of 16 is the fringed calyptra. 2. Leaves. 3a. Apices of leaves. 3b. Cells at base of leaf. 2x. Cross-section of leaf.

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cucullate. The costa does not reach the obtuse and rounded apex.

E. CILIATA (Hedw.) Hoffm., the Fringed Extinguisher Moss, is frequent on rocks in mountain regions. The plants are about one inch in height. The slightly excurrent costa, leaves plane-margined in the upper portion, and the fringed calyptra are its ear marks. The spores mature in summer.

FAMILY 11. ORTHOTRICHACEAE. The Orthotrichum Family.

SOMEWHAT resembling the Grimmia Family, but nearly always growing on trees. The plants are small, rarely reaching an inch in height and usually much shorter, blackish or brownish green below. The leaves are oblong- or linear-lanceolate and usually very hygroscopic. The calyptra is nearly always hairy and the capsules often immersed, with very distinct longitudinal wrinkles when dry and empty. The peristome usually consists of 16 rather short teeth which are nearly always reflexed when dry and are often united in pairs; the inner peristome is usually represented by 16 slender hairlike processes, almost too minute for the hand-lens. In the *First Edition* this family was united with the *Grimmiaceae*. Members of these two families may become so dry and brittle as to crumble to dust in the fingers and yet retain their vitality unimpaired, springing into renewed growth with the next rain.

FIGURE 28. *Drummondia clavellata.* a, × 1. b, × 10. c, Calyptra × 10. d, Empty capsule × 10.

DRUMMÓNDIA.

Drummondia is a common moss of the Orthotrichum family. It always grows on the bark of trees, but is easily dis-

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tinguished from its tree-growing allies by three characters. Its stems are long and closely applied to the bark of the tree, sending out short horizontal branchlets so thickly that the stems below become apparent only when the plant is removed. The capsule is on a long seta, the calyptra is cucullate, and the peristome is so small as to be scarcely apparent.

Drummondia is named for Drummond, one of the earliest collectors of American mosses. *D. clavellata* Hook. is our only species.

ULÒTA (Weissia of the First Edition.)

The Ulotas have the characteristic brownish-green or blackish-green color of the Orthotrichum family. They are distinguished from all save Orthotrichum by the hairy calyptra. Both Orthotrichum and Ulota grow on the bark of trees or more rarely on rocks, in cushions of varying size and thickness. The Ulotas growing on trees usually grow in more rounded tufts with the leaves more crisped when dry than is usual with Orthotrichum growing in similar situations. The books all say that the hairs on the calyptra of Ulota are flexuous, and those on Orthotrichum straight, but this distinction appears to be rather too fine for the amateur to profit by it. The capsules in both genera are erect and symmetric and quite regularly striate when dry with eight or sixteen ridges and as many alternating furrows. These ridges consist of cells larger, darker, and thicker-walled than the alternating tissue. The seta in Orthotrichum is so short that the capsule is nearly always partially immersed; in Ulota the seta is long enough to exsert the capsule entirely beyond the perichætial leaves.

U. Ludwigii Brid., the Puckered Ulota, has pear-shaped capsules, abruptly narrowed to the very small mouth; the ridges and furrows extend only a short distance from the mouth of the capsule, giving it the peculiar and characteristic appearance shown in the cut.

U. crispa Brid. The capsules of the Crisped Ulota have a much larger mouth and are striate for the entire length. The seta is shorter, the color is lighter, and the tufts are rather thicker than in the Puckered Ulota. In the not uncommon variety *crispula* of the Crisped Ulota the capsule is much shorter and is suddenly contracted into a neck, narrow and much

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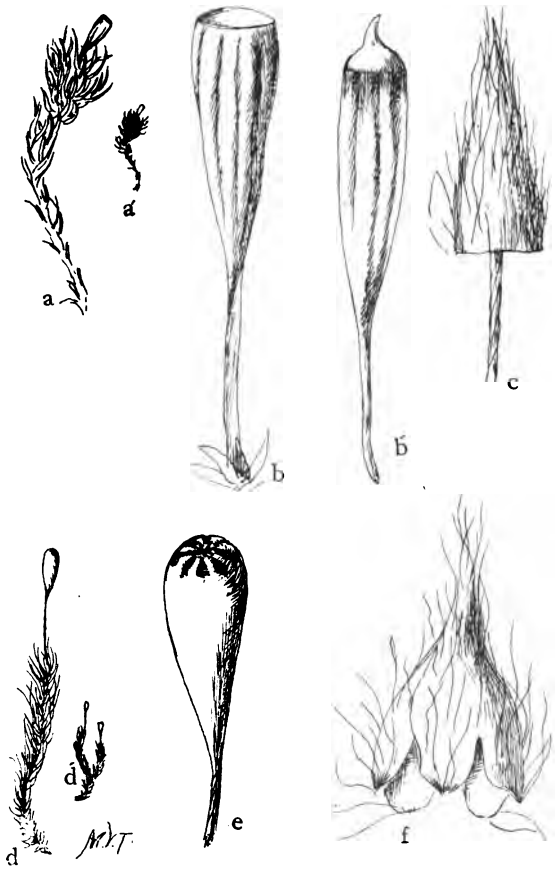

FIGURE 29. a, á, *Ulota crispa* × 4 and × 1 respectively. b, b′, Capsules of the same × 20. c, Young sporophyte with calyptra × 20. d. d′, *U. Ludwigii* × 4 and × 1 respectively. e, Capsule × 20. f, Calyptra of mature capsule × 21.

twisted when dry. These two species grow exclusively on trees.

U. AMERICANA (Beauv.) Lindb., the American Ulota, grows exclusively on rocks. Its leaves are rigid when dry like those of Orthotrichum, not crisped as in the two tree-growing species; the capsules very closely resemble those of the Crisped Ulota.

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All three of the Ulotas are common in the hilly regions of our range. Their capsules mature in autumn or early winter, but apart from the calyptra are more characteristic when dry and empty. The tree-growing species furnish good collecting for winter and early spring, when most other mosses are buried under the snow.

The use of the name Ulota instead of Weissia seems to be sanctioned by the best authorities, hence the change.

ORTHÓTRICHUM.

The Orthotrichums are most frequent on trees about houses, and in orchards and village streets, although they are not lacking in other situations where the trees stand somewhat apart. They can be found abundantly on almost any fruit or shade tree in the country. In the larger cities for some reason they do not seem to thrive. They may frequently be found growing with Ulotas, from which the immersed or emergent capsule and non-crisped leaves distinguish them at once. One species (*O. anomalum*) grows on rocks. The calyptras are less densely hairy than those of Ulota; *O. strangulatum* has a calyptra without hairs. The species are usually considered difficult to identify even with a compound microscope, but I find that a few of the commoner species can be recognized with the aid of a hand-lens. Capsules must be thoroughly dry to answer the description of dry capsules. The leaves have revolute margins, except in *O. obtusifolium,* which appear as a darker margin when the leaves are mounted on a slide. Drummondia has the general appearance of an Orthotrichum with an exserted capsule, but the calyptra is cucullate and without hairs and the capsule is not wrinkled when dry.

The plate of *O. sordidum* gives a good idea of the characteristics of the genus.

KEY.

1. Rock-inhabiting species; peristome teeth 16, erect or erect-spreading on dry capsules; capsule fully exserted, 16-striate....*anomalum.*
   Tree-inhabiting species; peristome teeth usually united into 8 pairs, recurved or reflexed when dry; capsule immersed or emergent, 8-striate.....2.
2. Leaves obtuse (rarely with some leaves acute), broad pointed, margins plane .....*obtusifolium.*
   Leaves acute, margins revolute or involute.....3.
3. Capsule almost or quite exserted, smooth, or very slightly plicate around the mouth when dry and empty.....*speciosum.*

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Capsules immersed or slightly emergent, plicate the whole length when dry ..... 4.
4. Empty capsule strongly contracted below the mouth when dry and empty, dark colored ..... 5.
Empty capsule only slightly contracted below the mouth, straw colored ..... *Ohioense.*
5. Empty capsules dark red-brown on the folds, so deeply folded in many cases that the folds almost touch each other; calyptra without hairs ..... *strangulatum.*
Plants larger with hairy calyptras; capsules lighter colored and less deeply plicate ..... *sordidum.*

O. ANOMALUM Hedw. Rock O. (Figure 31) grows on rocks in rather dense cushions, dark olive green or brown below; calyptra hairy; capsule usually fully exserted, 16-striate, the 8 intermediate folds less distinct, oval-cylindric when moist, cylindric when dry, abruptly narrowed to the neck. The peristome is erect when dry, *of 16 teeth,* usually separate. Spores maturing May-June. Not rare.

This species will not be confused with any other species of *Orthotrichum,* but may be confused with *Ulota Americana.* The latter has the dry capsule gradually narrowed into the long neck and the teeth *reflexed* when dry; besides it is almost black in color except at the extreme ends of the stems and branches, and grows in loose wide mats. Its spores mature much later, July-September.

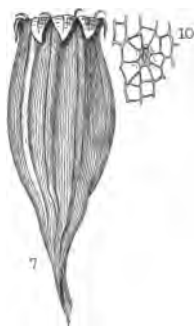

FIGURE 30. *Orthotrichum Ohioense.* Dry and empty capsule. 10 Stoma.

O. OHIOENSE S. & L. (Figure 30) grows in rather dense, small cushions, yellowish green, brown below; stems about 1-inch long; leaves oblong-lanceolate; calyptra hairy, moist capsule immersed, oblong-ovate, when dry slightly 8-plicate, campanulate, becoming more narrowed with age, *straw-colored;* peristome of 8 double teeth, strongly reflexed when dry. The spores mature in early spring (April). Common on trees. When sterile it is a difficult matter to distinguish this from *O. strangulatum,* but the straw-colored lightly-plicate capsules are easy of recognition.

O. SPECIOSUM Nees., the Smooth Orthotrichum, is perhaps the largest of our species, being an inch to an inch and a half in height, yellow-green above; leaves tapering, *very acute.* The calyptra is large, hairy, campanulate; capsule oblong-cylindrical, almost exserted, the upper leaves barely reaching the base, *smooth or barely marked with irregular ridges when dry;* oper-

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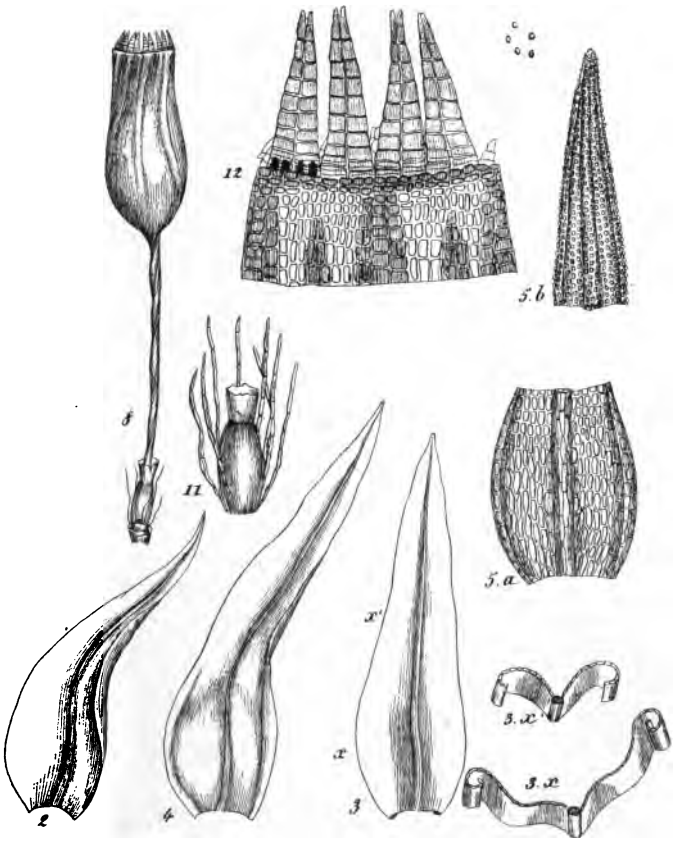

FIGURE 31. *Orthotrichum anomalum* (From Bry. Eur.).
2, 3, 4 and 5. Leaves; *x* and *x'* indicate where the sections *3x* and *3x'* were made. 11. Vaginula.

culum rostellate; peristome of 8 teeth, which when dry are recurved rather than reflexed, as the tip of the tooth sometimes touches the capsule wall in a way to remind one of the handle of a mug. The spores mature by October, but I have collected operculate capsules in March.

O. SORDIDUM S & L. somewhat resembles the preceding in leaf characters. It is at once distinguished by the immersed or

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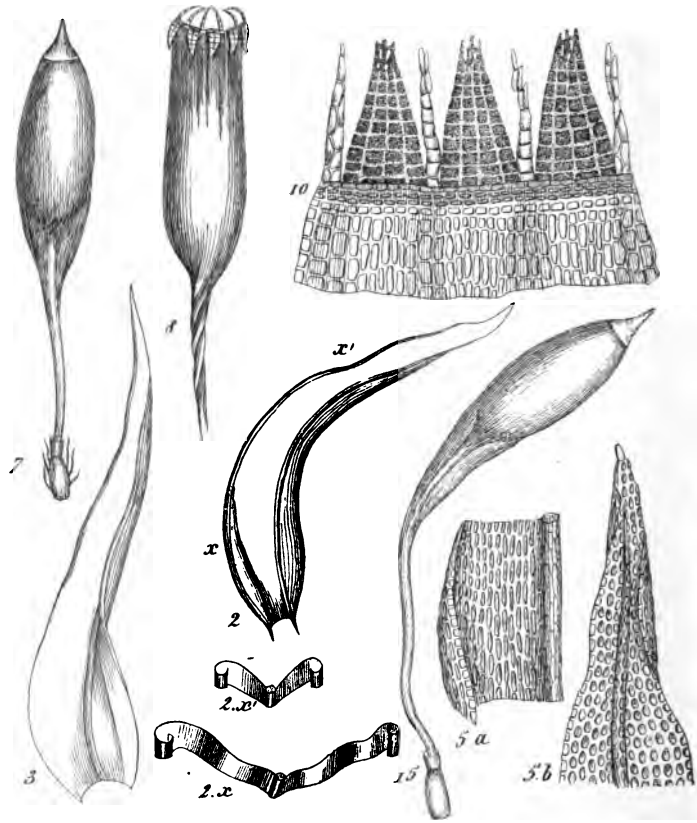

PLATE XXV. *O. speciosum* (From Bry. Eur.).
2, 3 and 5. Leaves. 7, 8. 10 and 15. Capsules and peristome.

PLATE XXVI. *O. sordidum* (From Sulliv. " Icones Musc. Suppl.")
1. Plants natural size. 3. Leaves. 4. Leaf sections. 5. Cellular structure of leaf base and apex. 12. Antheridial branch with antheridium and paraphysis. 11. Segment of peristome highly magnified. 13. Superficial stoma. The other figures are self-explanatory.

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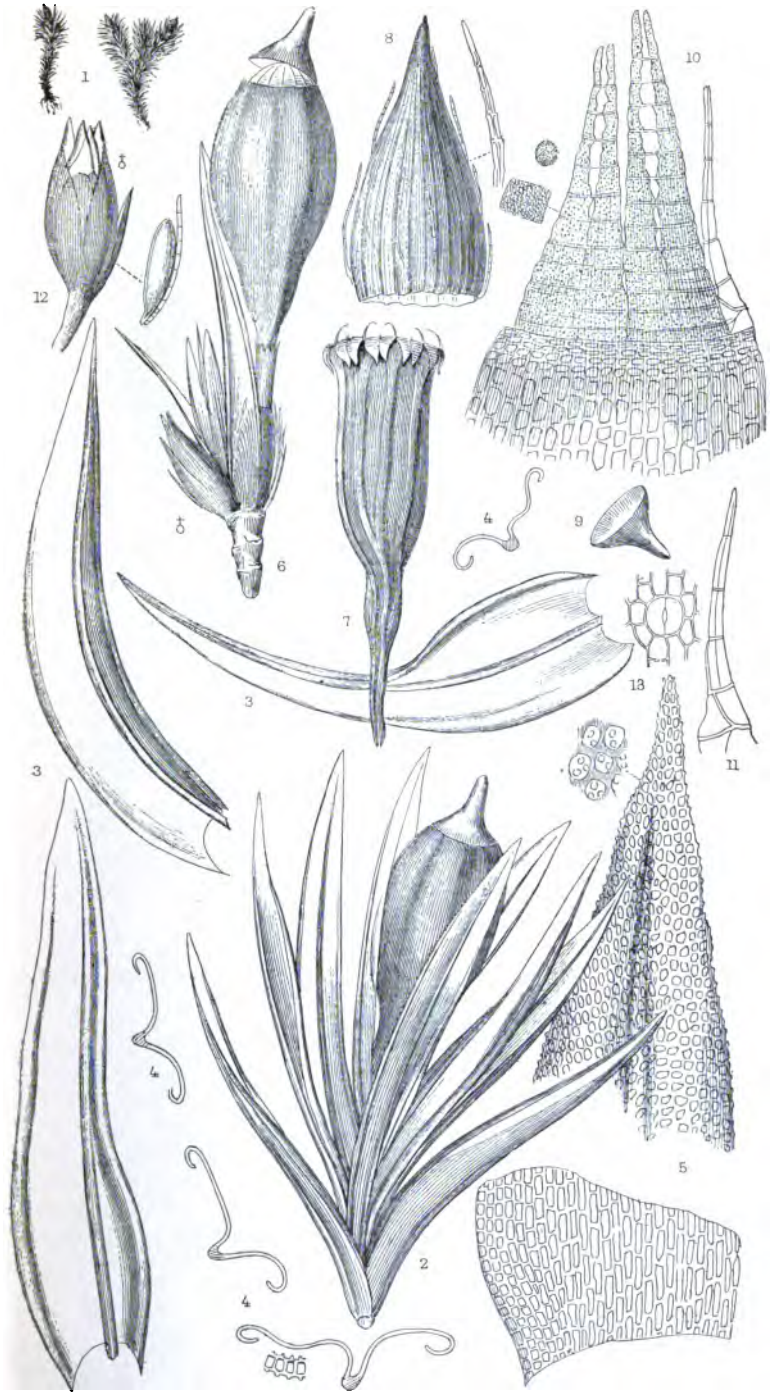

PLATE XXVI. Explanation on preceding page.

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emergent plicate capsules. The spores mature in late spring or summer.

O. STRANGULATUM Sulliv. (Figure 32.) This is one of our commonest mosses, abundant on shade trees almost everywhere. It can be recognized with a hand-lens by the characters given in the key if one is familiar with it. The capsules are not so deeply plicate until a month or more after the spores ripen. It is a little smaller than the preceding, the leaves are narrower, and the calyptra naked; the spores apparently mature about a month later.

FIGURE 32. Capsule of *Orthotrichum strangulatum.*

In August I have found *O. speciosum, O. sordidum, O. strangulatum,* and *O. Ohioense* growing together on fruit trees. *O. strangulatum* is much the most abundant, and is easily recognized by the strangulate, dark red-brown capsules appearing as described in the text. *O. Ohioense* is about the same size, but the straw-colored capsules catch the eye at once. *O. sordidum* stands out at once by reason of its greater size and larger leaves and capsules less plicate than in *O. strangulatum. O. speciosum* is somewhat smaller than *sordidum,* and at this time the capsules are immature with the hairy calyptra still firmly attached. The comparative size of *speciosum* and *sordidum* is just the reverse of what my herbarium specimens and the book descriptions lead me to expect as the specimens of *speciosum* I collected were much smaller than those in my collection.

FAMILY 12. SCHISTOSTEGACEAE. The Luminous Moss Family.

SCHISTOSTEGA OSMUNDACEA (Dicks.) Mohr., the Luminous Moss, belongs in a family all by itself because of its numerous peculiarities. It is found in caves and dark holes in the woods, sometimes under the roots of overturned trees. It has once been found under the sill of an old shed.

On looking into one of these caverns containing the Luminous Moss, the bottom seems covered with a golden-green glow, something like the appearance of a cat's eyes in the dark. In order

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to see the glow one must look into the cave in the direction from which the light enters and care must be taken not to shut off all the entering light, as the Luminous Moss, like the moon, shines by reflected light alone. If one attempts to gather the glowing substance he will find nothing but dirt and stones with possibly a few tiny green plants like those in the figure. The compound microscope will reveal threads like those shown in the plate, but the lens will show only a cobwebby appearance of fine green

FIGURE 33. *Schistostega osmundacea* (From Bry. Eur.). 1, 2. Plants natural size. 29. Protonema as it appears under the compound microscope.

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threads. This beautiful plant is probably the reality upon which are based the fairy tales of goblin gold. The discovery of this rare and curious plant will repay a search in every dark hole one sees. If present it can always be seen from the outside, as it cannot grow beyond the reach of light. Mrs. Britton's Observer articles give a much fuller account of this moss.

FAMILY 13. SPLACHNACEAE. The Splachnum Family.

SPLACHNUM.

THERE are several species of Splachnum, but only one is likely to be found.

S. AMPULLACEUM L., the odd looking moss represented in Fig 34, is not very common and will not be found readily by most students. It is so striking in appearance that no one can fail to recognize it. The spores are borne in the slender upper portion; the swollen and colored (lilac or purplish) lower portion is the neck of the capsule, which is covered with stomata and filled with loose tissue suitable for the assimilation of carbon dioxide. When dry this portion becomes irregularly shrunken in a manner very difficult to represent in a drawing.

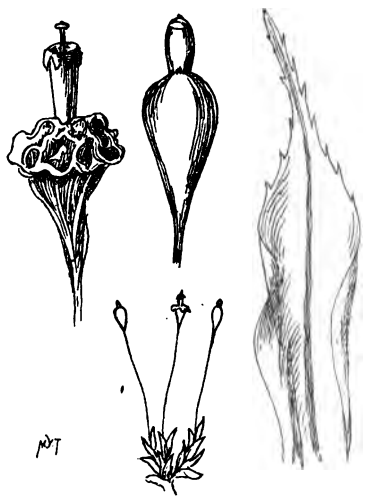

FIGURE 34 *Splachnum ampullaceum;* leaf × 10; capsule, ripe and unripe × 5. (The plant and capsules represented are rather small, as they are often found of twice this size).

There are several other rare mosses of the Splachnum Family, all remarkable for the swollen neck (much less conspicuous than in Splachnum, however), and for growing on animal excreta or decaying animal tissue.

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FAMILY 14. FUNARIACEAE. The Cord Moss Family.

FUNARIA.

FUNARIA HYGROMETRICA (L.), Sibth., the Cord Moss, is so-called because of the twisted seta, which is very hygroscopic and untwists when moist. Its Latin name, Funaria, is derived from *funis*, a rope. This twisting of the seta is not peculiar to this moss, however, but is a very common thing in nearly all moss families.

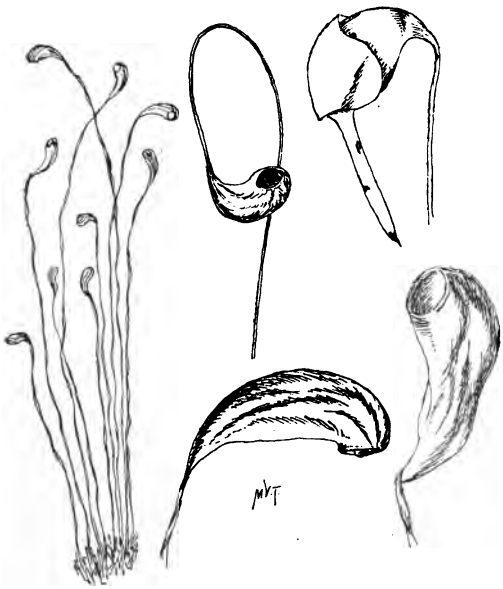

FIGURE 35. *Funaria hygrometrica* × 2, with capsules of various ages and degrees of magnification.

The Cord Moss is to be found everywhere, being especially abundant in waste places and on soil recently burned over. I have seen it completely cover the soil in an old strawberry bed. When mature it is easily recognized by the peculiar looking curved capsule with its mouth on one side. When immature it is much harder to recognize, because the capsule is erect and nearly symmetric and the calyptra has not assumed the rakish position indicated in the figures.

This moss has perhaps been given a more careful study than any other species; it is described in nearly every text book on botany. There are several other species in the United States, but this is the only one commonly found. The capsules mature early in June.

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F. FLAVICANS Mx. is found from New York southwards. We are indebted to Mr. R. S. Williams for the following notes which are taken from the "Bryologist" of January, 1901: "The species grows in separate tufts as well as mingled with *hygrometrica,* from which it may be distinguished by the average smaller size, erect pedicel, more pointed leaves, and mouth less oblique, as well as less furrowed capsule, which matures a week or two earlier than in *hygrometrica,* in this region at least, where the best specimens were collected from the 1st to the 10th of June. When well ripened, the capsules are very dark reddish, with a low convex lid, not apiculate." Mr. Williams also states that the mouth of the capsule is constantly smaller in *flavicans.*

PHYSCOMITRIUM. The Urn Mosses.

P. TURBINATUM (Mx.) Brid., the Common Urn Moss, is common on earth in conservatories, by roadsides and in old fields. It is abundant in moist places by paths in the parks of Greater New York. It must be collected in May to get the calyptra in position. Although a very near relative of the Cord Moss, it entirely lacks the peristome which is so conspicuous in that species.

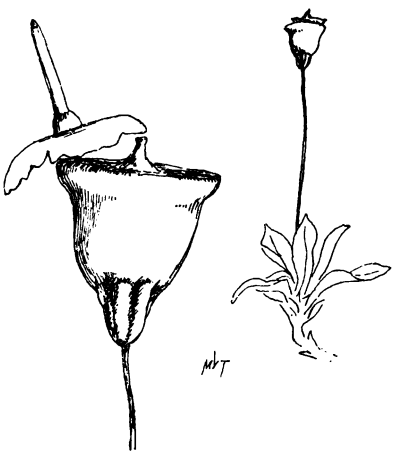

FIGURE 36. *Physcomitrium turbinatum* × 4; capsule × 15.

A much rarer moss, Pottia, may be found and confused with the Urn Moss, which it closely resembles. Pottia, however, is smaller, being about one-half as large, matures its capsules in winter, and under a lens will be seen to have the midrib excurrent instead of ending below the apex of the leaf, as in the Urn Moss.

There are several species of Urn Mosses, but this is much the most common and most likely to be met with.

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PÓTTIA.

Pottia belongs in the Tortula Family, but is treated here because of its resemblance to Physcomitrium. Plants short, branched, scattered or in tufts. Leaves soft, broad in outline, enlarging upwards, ovate to oblong, *costa reaching apex or beyond.* Capsule erect and exserted on a straight seta, ovoid to cylindric; peristome lacking in our species.

P. TRUNCATULA (L.) Lindb. (*P. truncata* Fuern.) is our only common species, and will be readily recognized from the generic description and the figure. It is most likely to be confused with Physcomitrium, as its habitat and general appearance are somewhat similar. The spores mature from late autumn to early spring.

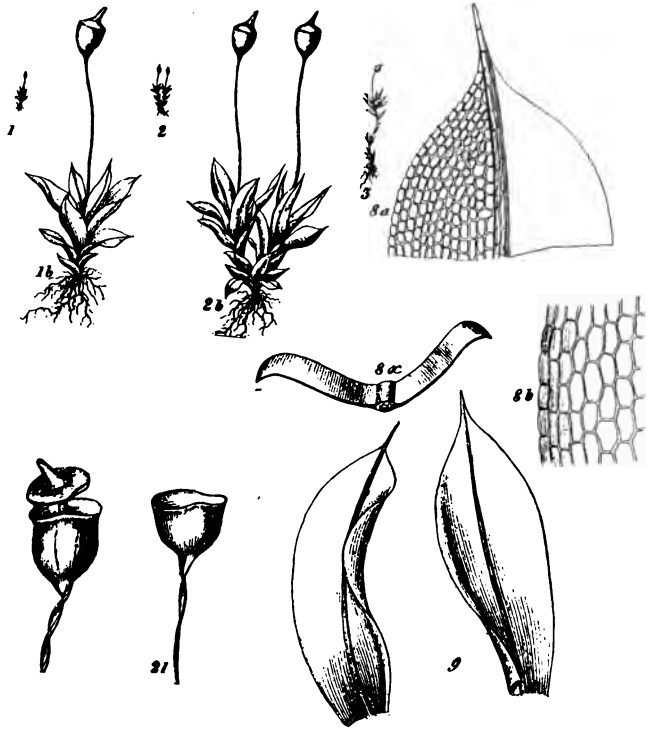

FIGURE 37. *Pottia truncatula* (From Bry. Eur.).
1, 2, and 3. Plants natural size. 8b. Leaf cells.

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FAMILY 15. AULACOMNIACEAE. Bog Moss Family.

CLOSELY related to the Mniums, but distinguished in our species by the capsules, which are strongly and regularly wrinkled when dry.

Gymnocybe has been dropped for Aulacomnium because the latter seems to be in most general use.

AULACÓMNIUM. The Bog Mosses.

A. PALUSTRE Schwaegr., the Ribbed Bog Moss, is very abundant in swamps and wet shaded hollows. It is rather lighter in color than most of the accompanying mosses. When in fruit it is readily distinguished by its capsules, deeply furrowed when dry. From the figures the capsules might possibly be confused with those of Ceratodon, but they are much longer and much

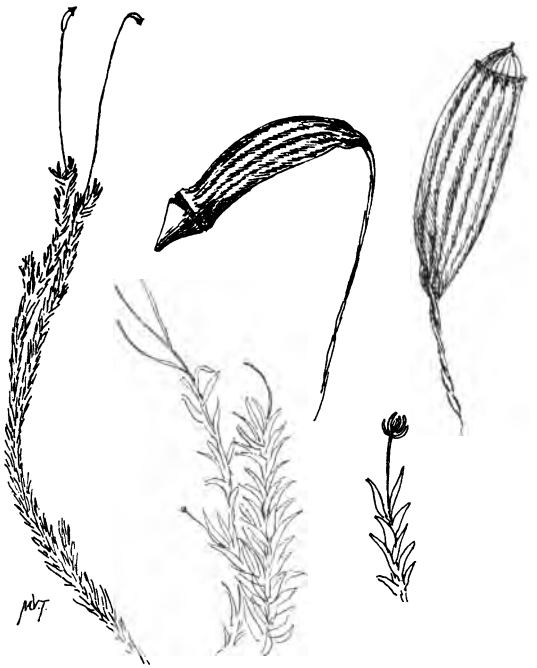

FIGURE 38. *Aulacomnium palustre* × 10; capsules × 10; pseudopodia × 4.

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PLATE XXVII. Explanation on next page.

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lighter colored (yellow-brown). The plants are several times as large as those of Ceratodon, often reaching a height of two or three inches. Note also the difference in habitat.

When not in fruit, this species frequently bears on the end of the stem a number of long slender pseudopodia, which, when young, bear clusters of gemmæ at their ends. These gemmæ serve to reproduce the plant asexually and may account for the rather infrequent appearance of the sporophyte.

The capsules mature in early summer.

A. HETEROSTICHUM (Hedw). B. & S. looks so much like a Mnium that it might well be called the Ribbed Mnium. It is common on rich moist soil (not wet) in woods, especially about the bases of trees. The ribbed, or wrinkled, capsules and broad Mnium-like leaves, coarsely serrate and without border, are its distinguishing marks. The spores mature in early spring, but the young "lances" are well started in the preceding autumn. When thoroughly dry the capsules are more strongly wrinkled and more contracted under the mouth than is shown in the plate.

FAMILY 16. BARTRAMIACEAE. Apple Moss Family.

THE plants of this family mostly grow on rocks that are moist or in many cases, very wet. The capsules are subspherical when moist, but are strongly wrinkled when dry.

BARTRÁMIA.

The Bartramias grow in moist niches in cliffs and on moist shady banks, looking much like tufts of green wool. The characteristic thing about them is their capsules, which are globular and somewhat unsymmetric when moist, but dry with regular folds and alternate ridges. When very dry the body of the capsule becomes so shrunken as to be smaller than the mouth of the capsule itself. We have two species.

B. POMIFORMIS (L.) Hedw., the Long-leaved Bartramia or Apple Moss, easily distinguished by its longer leaves crisped when dry and by its larger capsule.

PLATE XXVII. *Aulacomnium heterostichum* (From Bry. Eur.). 1, Plants natural size. The other figures are self-explanatory.

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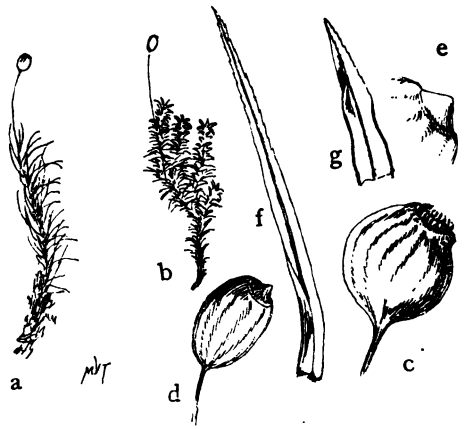

FIGURE 39. a, *Bartramia pomiformis* × 1. b, *B. Oederi* × 1. c, Capsule of *B. pomiformis* × 10, and e, Mouth of same with operculum. d, Capsule of *B. Oederi* × 10. f and g, Leaves of *B. pomiformis* and *B. Oederi* respectively × 10.

B. OEDERI (Gunn.) Swartz., the Short-leaved Bartramia. The Long-leaved Bartramia is common throughout our range whenever the country affords a suitable habitat, but the Short-leaved Bartramia is rather rare. The difference between the species as shown in the figures is so marked that they cannot be confused.

Both species mature their capsules in spring; the Long-leaved Bartramia in April or early May, and the Short-leaved two or three weeks later.

PHILONOTIS.

P. FONTANA (L.) Brid. is the only species of Philonotis likely to be met with, is very common where water drips or runs in shallow streams over rocks. When in fruit it may be mistaken for a Bartramia on account of the similarity of the capsules. The capsules of Philonotis, however, have a protuberance on the lower side that is entirely lacking in Bartramia.

Philonotis grows in much wetter places, has much longer, more slender stems that are often fasciculately branching at the top; shorter, more acute leaves, and is dioicous. The male heads are conspicuous objects among the fruiting plants, though sel-

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FIGURE 40. *Philonotis fontana* × 1; leaf, capsule, and male head × 10.

dom appearing in sterile mats. Although Philonotis is common, the sporophyte is infrequent. The capsules mature in May or June.

FAMILY 17. BRYACEAE. The Bryum Family.

THE capsules of the Bryum Family are nearly always drooping and frequently have a well marked neck when dry. The peristome is double and well developed. (See glossary under "Peristome"). The leaves are usually plainly bordered by a thicker darker margin of elongated cells, and the costa is stout and often excurrent.

BRYUM.

Bryum is perhaps the most difficult and troublesome of all the genera of mosses. The genus is large (500 species, 195 in Europe and America), and the distinctions between the species are often few and difficult to observe. There are, however, several species that can be recognized readily.

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It is hard to distinguish in a description between Mnium and Bryum, but after one has collected them much he will rarely make a mistake. In general the leaves in Bryum are smaller, and the leaf cells are longer and proportionately narrower. The Giant Bryum, however, is very like a Mnium in size and shape of leaf.

Many species other than those mentioned here are sure to be found, but the genus is one of the most difficult, and cannot be thoroughly studied with the hand-lens alone. Pohlia (Webera of many authors) is treated with Bryum because of its close resemblance. It is by many authors included in Bryum. The leaf cells in Pohlia are much longer and narrower than in Bryum, but it is difficult to see this satisfactorily with a lens.

B. ARGENTEUM L., the Silvery Bryum, grows everywhere at almost all altitudes. It is specially fond of dry compact soil in sandy fields and waste places. It grows abundantly in paths and between the bricks of sidewalks in towns and cities.

When fully grown it is a bright silvery gray, due to the fact that the leaves are white and without chlorophyll when old. The young plants are green and may easily be mistaken for something else. The leaves end in a slender bristle and are crowded and closely overlapping, making the stems and branches prettily julaceous.

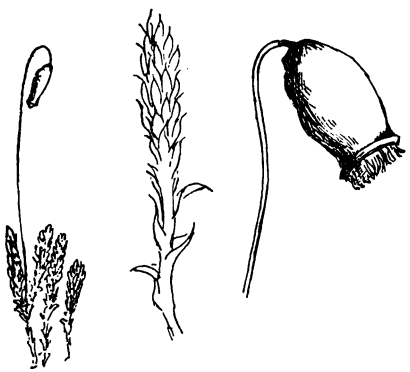

FIGURE 41. *Bryum argenteum* × 4; branch × 10; capsule × 20.

The capsules mature in autumn, but can be found in recognizable condition at almost any season. When fully mature the seta and capsules are dark red.

B. ROSEUM (Weis) Schreb, the Giant Bryum, is the largest and showiest of all our species, and, moist and fully expanded, is a striking object in any situation. The stems spring from stolons and are nearly leafless except at the summit, where the very large leaves form a rosette. Under favorable circumstances it forms large mats on old rotten logs or at the base of

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FIGURE 42. *Bryum roseum* × 1; leaf and capsule × 4.

trees in rich peaty soil. Although common, it seldom fruits in either America or England, but reproduces freely by its stolons.

The antheridia mature in late August or early September, and the male heads are so large and conspicuous that it is easy to find them in almost any locality where the species grows. The antheridia are so large as to be easily seen with a hand-lens. One who has access to a compound microscope should not fail to study the antherozoids with high powers.

B.CAESPITICIUM L., the Common or Matted Bryum. There is no particular reason for calling this species "matted" except to translate its scientific name, but it is by all odds the most common species. It grows among thin grass in open fields, around the edges of ledges and bare spots of soil, and on old ash heaps; usually in dry places. It is often associated with Funaria. There are two or three species so closely related to it that it is almost impossible to distinguish them with a lens, but this is so much more common than any of the others that in nine cases out of ten anything answering to the following description and figures will be the Common Bryum. The size and general appearance of the plants are well represented in the cuts. The leaves are plainly bordered; the costa is excurrent; the antheridia

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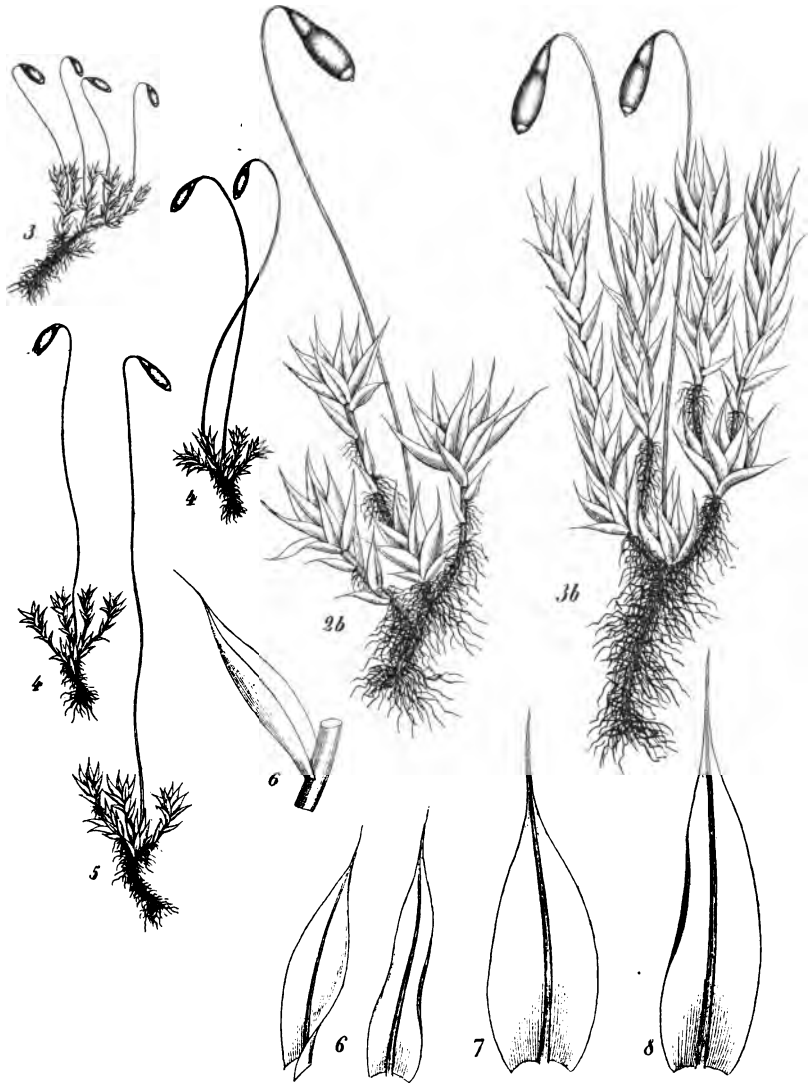

PLATE XXVIII. *Bryum caespiticium* (From Bry. Eur.). 3, 4 and 5. Plants natural size. 2b. and 3b. Plants magnified. 6, 7 and 8. Leaves.

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grow intermingled with the archegonia (difficult for the lens). The capsules mature in May and June, and as the antheridia and archegonia are ripe at about this time, it must take the plant a full year to mature its spores; for this reason the leaves at the base of the seta are often badly torn and decayed.

B. BIMUM Schreb., the Red-stemmed Bryum, is another common species, growing on wet cliffs and in swamps. It is known by its large size (2-6 inches) and the dense felt of red-brown radicles that cover its stem. The leaves are rather distant, 1-12 of an inch or more long, plainly bordered, with costa percurrent or excurrent, and red in old leaves. This species is exceedingly variable in size and general appearance and one who has collected it several times cannot feel sure that he will recognize it the next time he finds it. The spores mature in midsummer.

FIGURE 43. Portion of stem of *Bryum Duvallii* much enlarged (From Bry. Eur.).

B. DUVALLI Voit., the Winged Bryum, is a rare plant growing in elevated swamps, but is so peculiar as to be easily recognized even when sterile. The stems are slender and weak with leaves very far apart, much farther than the cut would indicate, and so strongly decurrent as to make the stem appear winged. They are scarcely margined, and the costa is not excurrent.

POHLIA NUTANS (Schreb.) Lindb., the Nodding Byrum, is one of the mosses most frequently sent me for determination. It grows everywhere in moist or swampy places on peaty soil, rotten wood, etc. The plants vary from ½ to 2 inches in height, rarely over an inch as I find them. The upper leaves are long and narrowly lanceolate, faintly serrate at apex, and not margined. The costa is strong and ends below the apex. With the

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PLATE XXIX. *Pohlia nutans* (From Bry. Eur.). 1 and 2. Plants natural size. The other figures are self-explanatory.

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lens the costa appears to be percurrent and the leaves entire. The spores mature in early summer.

POHLIA ELONGATA Hedw. is a rather rare moss found only in the mountains. It grows on damp soil in cool shaded places. It is at once known by the slender long-necked capsule

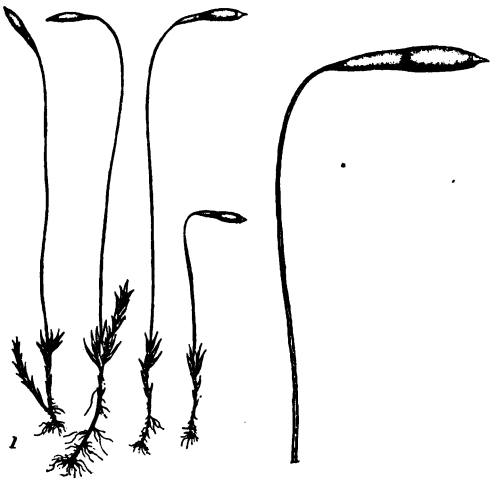

FIGURE 44. *Pohlia elongata* natural size and capsule enlarged. (From Bry. Eur.).

FIGURE 45. *Leptobryum pyriforme* × 2; leaf and Capsule × 10.

which is never to be confused with the Long-necked Bryum because of the different position of its capsules and its broader, lanceolate leaves. The spores mature in August.

LEPTOBRYUM PYRIFORME (L.) Wils., the Long-necked Bryum, is closely allied to the true Bryums, although placed in another genus. It is easily recognized by its long-necked capsule and

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slender hair-like leaves. The capsules mature in June and July.

Some species of *Pohlia* have very long-necked capsules, but the leaves are so much wider that there is no need of confusing them with the Long-necked Bryum.

This species is frequent on moist shaded cliffs and on rocks near water. It is not as rare as the author once thought, for it is frequent on damp mortared walls in various situations. The author has collected it on the basement of his Brooklyn house and in the cut which leads up to Montague Street from the Brooklyn end of the Wall Street Ferry.

MNIUM.

The Mniums are closely related to the Bryums, but in habit and general appearance are different enough so that they can usually be distinguished without difficulty. As a rule, the plants are larger and broader. The Giant Bryum, however, looks very much like the Mniums.

There are numerous species of Mnium, many of them common. We have about ten that are common enough and sufficiently well characterized to warrant description here.

KEY.

1. Leaves margined ..... 2.
   Leaves not margined ..... 11.
2. Leaves entire ..... 3.
   Leaves serrate ..... 4.
3. Growing on rocks in the bed of brooks ..... *punctatum.*
   Growing on soil in shaded swampy places ..... *punctatum elatum.*
4. Capsules clustered ..... 8.
   Capsules single ..... 5.
5. Leaves serrate to base ..... *affine ciliare.*
   Base of leaves entire ..... 6.
6. Leaves oblong-lanceolate, 5:1 ..... *hornum.*
   Leaves oblong, rounded, or obovate ..... 7.
7. Mouth of capsule (peristome) red ..... *spinulosum.*
   Mouth of capsule not red ..... *sylvaticum.*
8. Leaves tapering to the acute apex ..... 9.
   Leaves obtuse and rounded at apex, mucronate by the excurrent costa ..... *rostratum.*
9. Teeth at margins of leaf double; peristome red ..... *spinulosum.*
   Teeth at margin of leaf not double; peristome not red ..... 10.
10. Plants dioicous, with stolons ..... *affine.*
    Antheridia present at base of seta; stolons lacking ..... *Drummondii.*
11. Plants very large resembling large forms of the Large-leaved Mnium ..... *cinclidioides.*
    Plants small ..... *stellare.*

M. SYLVATICUM Lindb., Woodsy Mnium. One of the first signs of vegetable life in early spring is the array of upright green sporophytes of the Woodsy Mnium, which is common in lawns and parks in moist shady corners, and is to be found abundantly

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in moist woods everywhere, growing, sometimes on the soil, sometimes on rotten wood. The capsules mature in May, but can be found in recognizable condition until August.

M. AFFINE CILIARE (Grev.) C. M., the Toothed Mnium, closely resembles the Woodsy Mnium in many respects, but is easily distinguished by the leaves. The leaves of the Toothed Mnium are serrate with very long and slender teeth, which extend to the base of the leaf. In the Woodsy Mnium the leaves are serrate with shorter teeth that do not extend much below the middle of the leaf. Until one has had some practice, it may be necessary to mount the leaves in order to see the serration plainly. No reliance should be placed on the shape of the leaves in distinguishing these two species, as the leaves vary greatly in shape in different plants and on different parts of the same plant.

M. AFFINE Bland. The common form of this species is the variety described above. The species is rather rare and is a puzzling form for the hand-lens student. The figures and description of *M. Drummondii* in the FIRST EDITION were based on this species largely. It has the capsules clustered, and teeth on the margins of the leaves shorter than in the Toothed Mnium. It is distinguished from *M. Drummondii* by the longer, less decurrent leaves, absence of creeping stems, and by having antheridia and archegonia on separate plants. The male heads bearing antheridia can usually be found mixed with the plants bearing capsules.

M. DRUMMONDII B. & S., the true Drummond's Mnium, is so infrequent as not to require a treatment here. It is distinguished from *M. affine* by the characters given under that species. By carefully stripping off the perichætial leaves and mounting them and the seta on a slide the presence of antheridia can usually be made out with a high power lens.

M. SPINULOSUM B. & S., the Red-mouthed Mnium, is a third species somewhat resembling the Woodsy Mnium and growing in similar situations, but less common and usually growing in woods. The peristome is a very bright red-brown, and after the operculum has fallen it makes a very conspicuous red band about the mouth of the yellowish-white capsule. If the leaves of the Red-mouthed Mnium be carefully studied, the teeth on the margins will be seen to be in pairs. To see this with a hand-lens requires considerable care, as the teeth are small and hide one another. The capsules mature at least two weeks later than

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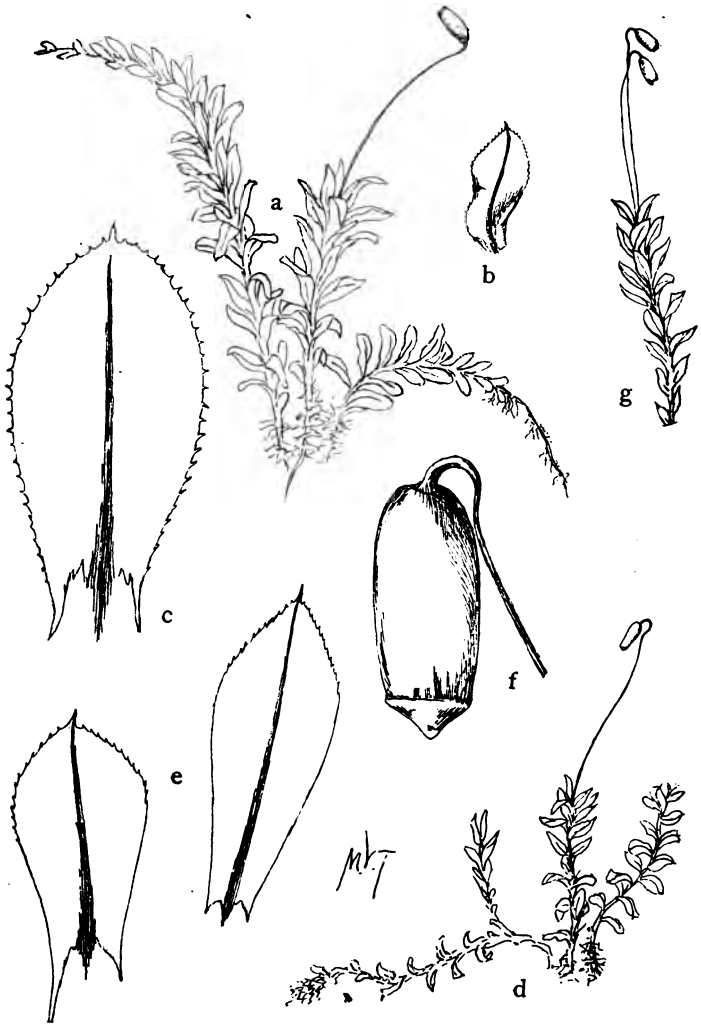

PLATE XXX. *a, Mnium affine ciliare* × 1. b, Leaf × 4. c, Leaf × 10. d, *M. sylvaticum* × 1. e, Leaves of different shapes × 10. f, Capsule × 10. g, *M. affine* × 1.

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those of the Woodsy Mnium. Before the lid has fallen its pronounced beak is an aid in identification. In Europe the capsules of this species are usually clustered, but in the eastern United States I find the great majority of plants with single capsules. The plants also seem rather smaller than the Western and European forms.

FIGURE 46. *Mnium hornum*. (From Bry. Eur.). Plant natural size.

M. HORNUM L. There are several species of these double-toothed Mniums, but the only other one readily recognizable with a simple lens is the Long-leaved Mnium, whose leaves are proportionately much longer and narrower, with the costa ending below the apex. It is dioicous and the disc-like male heads are an additonal aid in identification. This species is more abundant southwards and is frequent around New York City in shaded springy places. It does not appear to fruit freely, but if one can find fruit in April with the calyptra in its queer position on the seta, instead of on the capsule, he can make no mistake. (See Pl. 31, o.)

M. ROSTRATUM Schrad., the Beaked Mnium, is a fairly common species which seems to fruit infrequently. The leaves are oblong to obovate and rounded at the apex with the costa running abruptly out into a short point. They do not taper as in most species, but are rounded at apex into an outline nearly semicircular. The border is strong and the teeth single, sometimes rather short at the apex. The capsules are clustered and strongly beaked, as in the Early Mnium, but the plants seem to spread largely by stolons which form loose mats over the soil in moist shaded places. The antheridia are mixed with the archegonia. The spores mature in spring.

M. PUNCTATUM L., the Early Mnium, grows on moist stones in the bed of brooks. It matures its capsules in April, long before any other species. It is at once recognized by its obovate entire-margined leaves and beaked operculum.

M. PUNCTATUM ELATUM Schimp., the Large-leaved Mnium, is said to be merely a variety of the Early Mnium growing in the mud in swampy places. It is often much larger than the figure.

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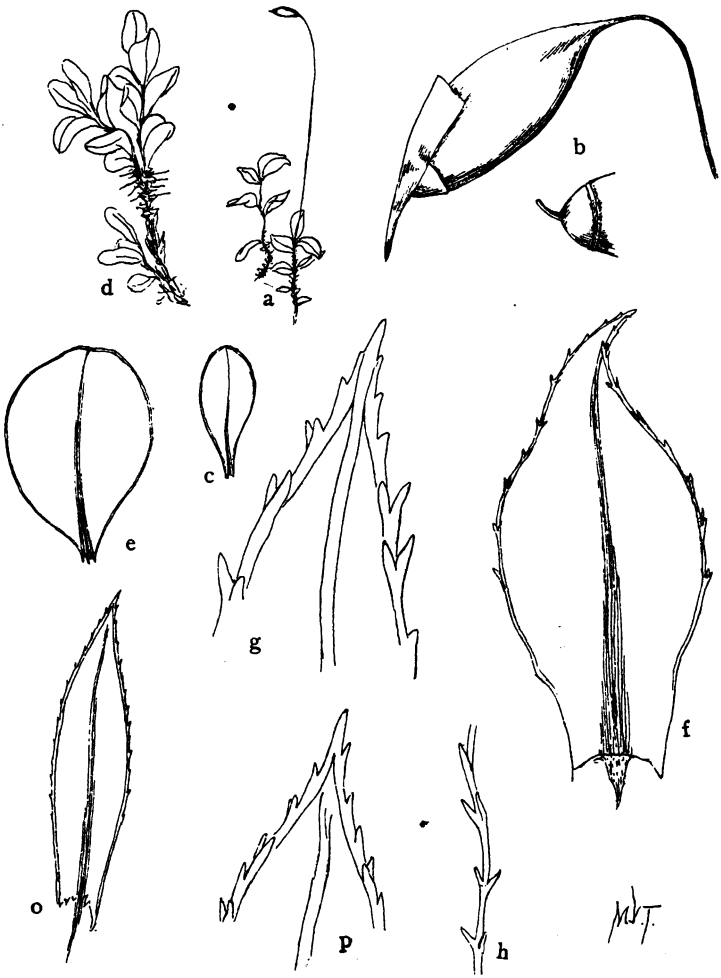

PLATE XXXI. a, *M. punctatum* × 1. b, Capsule and operculum × 10. c, Leaf × 4. d, Var. *elatum* × 1. e, Leaf of var. *elatum* × 4. f, Leaf of *M. spinulosum* × 20. g and h, Apex and margin of same × 40. o, Leaf of *M. hornum* × 10. p, Apex of the same × 40.

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sometimes having leaves half an inch long. The leaf cells are so large as easily to be seen with a lens and in some cases with the naked eye of a trained observer.

The two species without borders to the leaves are rather infrequent and so different as to remove all danger of confusion.

M. CINCLIDIOIDES (Blytt.) Hueben. is a very large moss four to six inches high, said to have been found a foot long, and looking almost exactly like an overgrown Large-leaved Mnium. The leaves are larger and oblong and when mounted show no trace of a border. This is a rare species of cool bogs.

M. STELLARE Reich. is a small moss usually less than an inch high, though sometimes becoming more than two inches in length. It grows in rather dense cushions at the base of trees in swampy woods. Although frequent it rarely fruits. The leaves are elliptic-oblong with no trace of margin and teeth too fine to be seen with a lens; the costa ends farther below the apex than in any other species included here.

Pleurocarpous Mosses.

The remainder of the mosses have creeping stems, seta arising from short lateral branchlets and peristome double.

FAMILY 8. LESKEACEAE. The Leskea Family.

ALL the members of this family except Thuidium have erect capsules. The leaf cells are so strongly covered with little projections as to make them less transparent than in most other pleurocarpous mosses. The Twisted Mosses, it will be remembered, had leaves that were subopaque for the same reason.

ANOMODON.

The bases of trees in cool moist woods frequently wear an apron of dark green, extending from the roots to three or four feet above the ground and often entirely encircling the trunk. This "apron" is usually composed of one or more species of Anomodon, often mixed with an Hepatic *(Porella)*. The mats of Anomodon are quite thick and are composed of a network of nearly leafless stems growing close to the bark and

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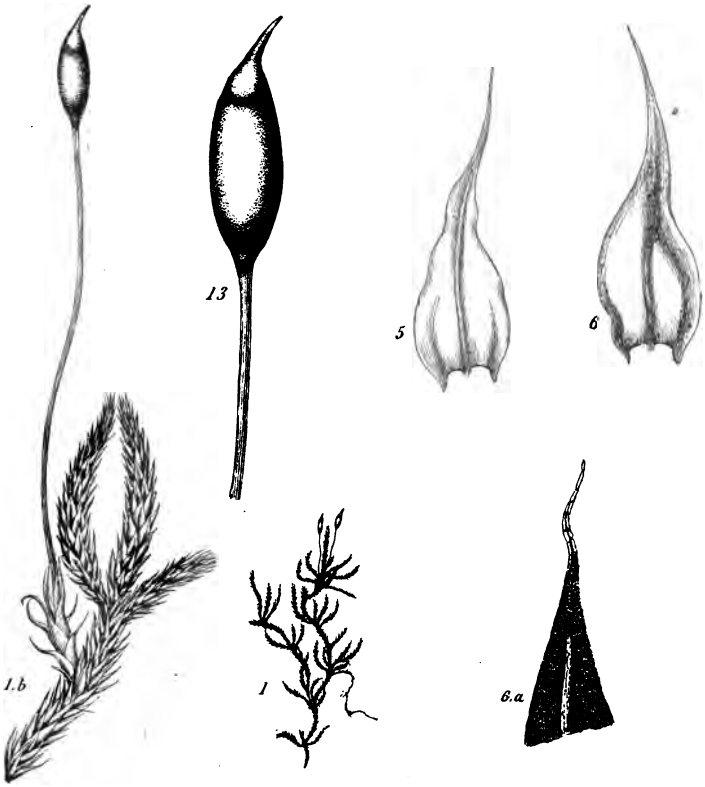

FIGURE 47. *Anomodon rostratus* (From Bry. Eur.). 1. Plant natural size.

sending out the crowded branches that compose the "pile" of the mat. The Anomodons are nearly all rather coarse mosses with the sporophyte arising from the *branches*. The capsules are conic-cylindrical, straight, and erect.

Some species of Leskea grow in similar situations and have a very similar sporophyte, but the Leskeas are much smaller, do not produce such dense mats, and the sporophyte arises from the *stem*.

There are three species of Anomodon growing on trees as described above. The Common Anomodon, the Blunt-leaved Anomodon, and the Slender Anomodon.

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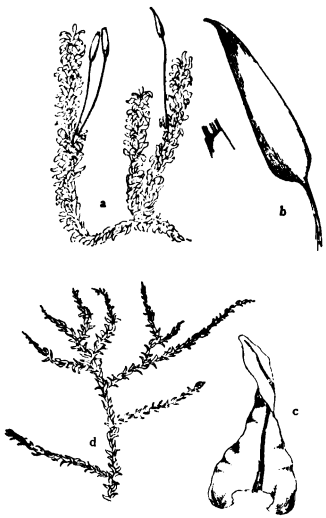

FIGURE 48. a, *Anomodon apiculatus* × 2. b, Capsules × 10. c, Leaf × 10. d, Branch of *A. attenuatus*, moist, × 2.

A. APICULATUS B. & S., the Common Anomodon, and *A. minor* (P. Beauv.) Fuern., the Blunt-leaved Anomodon, resemble each other so closely that it is not easy to distinguish them without a compound microscope. Both have simple blunt branches and grow almost exclusively on trees.

A. ATTENUATUS (Schreb.) Hueben., the Slender Anomodon, grows freely on rocks as well as trees; its branches are slender and tapering, and freely branched. It almost never fruits.

A. ROSTRATUS (Hedw.) Schimp. grows in dense mats like a very coarse velvet. It is found in wet places particularly at the foot of trees in swamps, growing on the ground rather than the tree. It is also common at the base of wet cliffs and on wet rocks where a little soil has collected. The leaves are different from those of any of the other species and are easily recognized when mounted, by the shape and the hair-like apex. The spores are ripe in late autumn.

THELIA.

THELIA HIRTELLA (Hedw.) Sulliv., the Common Thelia, is very common in the southern and coastwise portion of

FIGURE 49. *Thelia hirtella* × 4; leaves × 20.

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our range. It grows almost exclusively on the bark of stumps and the bases of trees. It forms thin closely adherent mats, easily recognized by their whitish-green color, erect symmetric capsules with whitish peristome, julaceous branches, and concave suborbicular leaves. The capsules mature in autumn.

THELIA ASPRELLA (Schimp.) Sulliv. has a range and habitat very similar to that of *T. hirtella,* but is even lighter in color; when fresh, light glaucous-green. *T. Lescurii* Sulliv. is very similar to the above named species, but grows in rather *dry soil.* It is confined to the more southern coast regions (northern limit Connecticut). It rarely produces capsules, while the other species fruit freely.

THUIDIUM. The Fern Mosses.

The Fern Mosses have been noted by every lover of out-of-door life because of their delicate and beautiful fern-like form. The branches are given off very regularly like the pinnæ of a fern, and the branches themselves often give off branchlets as regularly as the pinna of a fern is divided into pinnules.

T. SCITUM (Beauv.) Aust., the Smaller Fern Moss, is the one most likely to be met with, especially in the northern portion of our range. The capsules, besides being much smaller than in the Common Fern Moss are only slightly cernuous and are nearly symmetric. The capsules mature in autumn.

T. ABIETINUM (L.) B. & S., Wiry Fern Moss, is another simply pinnate species that is common. This moss is most frequently found in dry sterile places on the ground among the grass, and on ledges. It varies considerably in appearance according to habitat and its immediate condition as to moisture. Usually it is very evenly and regularly pinnate. Though frequent, it is very rarely found fruiting in our latitude. Mr. R. S. Williams, however, found it fruiting freely in Alaska. Mr. Williams also reports several other similar cases, one of the most conspicuous being *Hypnum rugosum* L.

T. DELICATULUM (L.) Mitt., the Common Fern Moss, grows in damp shady places over stones and earth, rotten logs and the like. It is very regularly twice or even thrice pinnate. It grows abundantly in suitable situations throughout our range, but produces capsules rather sparingly. These mature in early autumn

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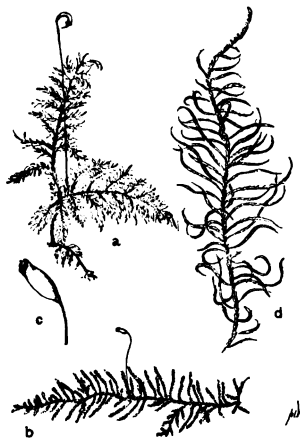

FIGURE 50. a, *Thuidium delicatulum* × 1. b, *T. scitum* × 1. c, Capsule of the same × 5. *T. abietinum* × 1.

and are very large, much curved, and are borne on long stout setæ. The perichætial leaves bear long cilia along their upper margins. This is one of the characters by which this species can be distinguished readily from another closely related species, *T. recognitum*.

T. RECOGNITUM (Hedw.) Lindb. will not be distinguished from the Common Fern Moss except by close scrutiny. The perichætial leaves are not ciliate and the stem leaves when moist are spreading-recurved instead of erect-spreading, as in the Common Fern Moss. The shape of the stem leaves is also different; the figures explain these differences better than any description. Both species grow on the ground, stones, or rotten wood, but this matures its spores in July, the other in early winter.

FIGURE 51. Portion of stem and leaves of *Thuidium recognitum*, at the left. Same of *T. delicatulum*, at the right.

Growing on the bark of trees are several smaller species that are usually only once pinnate.

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HYLOCOMIUM PROLIFERUM (L.) Lindb. (*H. splendens* of many authors), the Mountain Fern Moss, although belonging to a different genus from the other fern mosses, is best treated in connection with them because of its similarity in form. As will be seen by the figures it is much larger and has a very peculiar and characteristic habit. Every year each of the main shoots of the previous year develops a single fern-like shoot from the middle of the upper side instead of branching out from the side of the shoot as in the case of most mosses. This gives the plant

FIGURE 52. *Hylocomium proliferum* × 1.

its peculiar habit and its botanical name of "*proliferum*." It is one of the too rare cases in which the botanical name is descriptive of the plant to which it is applied.

This moss grows abundantly in cool moist mountain woods on stones and old logs. When found growing elsewhere it is so stunted as to give no idea of its beauty in its favorite habitat. The capsules, which mature in autumn, though not rare, are sparingly produced in proportion to the number of plants. When a patch does fruit, however, it often fruits heavily.

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FAMILY 19. HYPNACEAE. The Hypnum Family.

THE preceding species belongs to the great Hypnum Family, which contains a vast number of our common mosses. The majority of the members of this family are slender and prostrate, or creeping with ascending branches. The sporophyte varies a good deal, but the capsules are more or less unsymmetric and cernuous in most species. The members of this family usually grow in dense thin mats on soil, stones, rotten wood, and bark of trees. There are hundreds of species belonging to this family and the number within our own range is very large. Many of the species and even genera are so closely related and are distinguished by so few and so minute differences that no one but a trained and expert student of mosses can name them correctly. For this reason only a few of the most strongly marked species can be treated here. This is to be regretted, for many of the commonest mosses will thus be omitted and the student will be discouraged by finding so many things that he cannot identify. It is safe advice to the beginner to leave the Hypnums until he has studied the more easily recognized mosses.

Roughly, the more common genera are distinguished thus: Plagiothecium and Entodon are flattened in a plane parallel to the substratum, but the capsules of Entodon are erect and symmetric, while those of Plagiothecium are curved and cernuous. Brachythecium has very short ovoidal capsules that are cernuous and somewhat curved (except *B. acuminatum* and *B. oxycladon);* the leaves have a strong midrib. *Eurhynchium, Cirriphyllum,* and *Rhynchostegium,* have the strong midrib and short capsules of *Brachythecium,* but the opercula are grotesquely long-beaked, much as in *Dicranum. Raphidostegium* has long-beaked capsules like the three genera mentioned above, but the leaves lack the midrib. *Pylaisia* grows exclusively on the bark of trees, and is dark green; the short branches are strongly curved at the end when dry, and the capsules are erect and symmetric. *Hypnum* has so many varying forms that one can best get an idea of it from studying the individual species described below.

Nearly all the genera of the family were formerly included in the genus Hypnum and the appearance of the species throughout the family has such a similarity that Hypnum can appropriately be used for the common name of many species scientifically

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included in other genera. Also it will frequently be more helpful to group species from different genera with a similar appearance rather than to put all species of a genus together.

KEY TO THE HYPNUM FAMILY.

1. Leaves strongly turned to one side (secund)..... 2.
   Leaves not secund..... 8.
2. Leaves with a midrib..... 3.
   Leaves without midrib..... 4.
3. Plants very robust, never fruiting; leaves wrinkled crosswise.....*Hylocomium rugosum.*
   Plants slender to moderately stout; leaves often wrinkled lengthwise, never crosswise.....Hooked Mosses.
4. Capsules wrinkled lengthwise when dry.....*Hypnum curvifolium.*
   Capsules not appreciably wrinkled when dry..... 5.
5. Capsules long-beaked; alar leaf cells much enlarged and hyaline.....*Raphidostegium.*
   Capsules not long-beaked; alar cells not much enlarged..... 6.
6. Plants plume-like; capsules strongly curved..*Hypnum crista-castrensis.*
   Plants pinnately branching but less plume-like; capsules erect or only slightly curved..... 7.
7. Plants slender; dry capsule with mouth oblique.....*H. reptile.*
   Plants more robust, almost always on rotten wood; mouth of dry capsule not oblique.....*H. imponens.*
   Plants growing on stones in cool brooks.....*H. ochraceum.*
8. Growing in water.....Water-loving Hypnums.
   Growing in various situations, often in wet places but not in water..... 9.
9. Leaves with midrib; capsules very short and stout, not more than three times as long as broad.....*Brachythecium* and the Beaked Mosses.
   Leaves with midrib; capsules more than 3:1.....10.
   Leaves without distinct midrib.....11.
10. Plants large, with a treelike habit; leaves appressed when dry; capsules cylindric and straight.....*Climacium.*
    Plants stout, suberect; leaves spreading when dry; capsules curved.....*Hylocomium triquetrum.*
    Plants slender, creeping..*Amblystegium* and *Hypnum chrysophyllum.*
11. Capsules erect and cylindric.....15.
    Capsules more or less curved.....12.
12. Capsules wrinkled when dry.....*Plagiothecium striatellum.*
    Capsules smooth when dry.....13.
13. Leaves appearing flattended into two ranks.....*Plagiothecium.*
    Leaves not flattened into two ranks.....14.
14. Plants bright golden green, usually growing on soil.....*Hypnum Schreberi.*
    Plants green, usually growing on decaying wood... *H. Haldanianum.*
15. Plants usually growing on bark of trees.....*Amblystegium adnatum* and *Pylaisia.*
    Plants usually growing on soil or decayed wood or over stones.....*Entodon* and *Hypnum Haldanianum.*

HYPNUM.

In one section of this composite genus the leaves are all turned to one side (secund), and the branching is more or less regularly pinnate, giving the plants a plume-like appearance in many cases. The leaves are without midrib. This section is often called *Hypnum* proper. Two of the most common and

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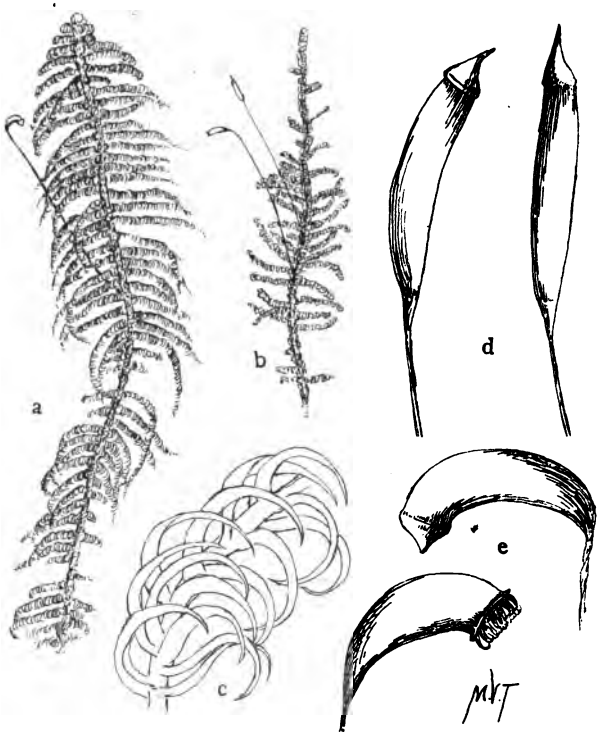

FIGURE 53. a, *Hypnum crista-castrensis* × 1. b, *H. imponens* × 1. c, Portion of branch of *H. crista-castrensis* × 10. e, Capsules × 10. d, Capsules of *H. imponens* × 10.

easily recognized mosses of this group are the Plume Moss and the Pinnate Hypnum.

H. CRISTA-CASTRENSIS L., the Plume Moss, is common on decayed wood and stumps in cool moist woods in New England and New York, and probably throughout our range. A few starved specimens have been collected on Long Island. To be appreciated this moss should be seen in the cool moist recesses of the primeval mountain forests, where it covers the fallen and decaying trunks of huge trees with ample robes of richest texture. The shoots are ascending and as regularly pinnate as any feather, even to the triangular apex of the shoot. Its color is a

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light yellow-green. Its capsules are strongly curved and cernuous; they mature in autumn.

H. IMPONENS Hedw., the Pinnate Hypnum, is a much more common moss in the lowlands and grows almost exclusively on rotten wood in moist shady places. It somewhat resembles the Plume Moss, but is prostrate, forming dense closely cohering mats. It is also darker green; the capsules are nearly erect and symmetric, and the pinnate branching stops short of the apex of the shoots, as is shown in the figure. A careful examination will show that there is a difference in the curvature of the leaves; in the Pinnate Hypnum the leaves curve towards the substratum at right angles to the plane of the stem, while in the Plume Moss they curve towards the branch next below on the stem. The capsules of the Pinnate Hypnum are produced much the more freely; they mature in winter, but persist in good condition for a long time.

HYPNUM CURVIFOLIUM Hedw. is a much rarer moss that somewhat resembles *H. imponens* when sterile. It is more confined to the mountains, is larger, lighter colored, and has curved cernuous capsules that are very strongly furrowed when dry. The leaves when dry are so regularly arranged as to give a characteristic appearance like a carefully dressed braid of hair.

H. PATIENTIAE Lindb. has furrowed capsules almost like those of the preceding and its general appearance is so similar that it

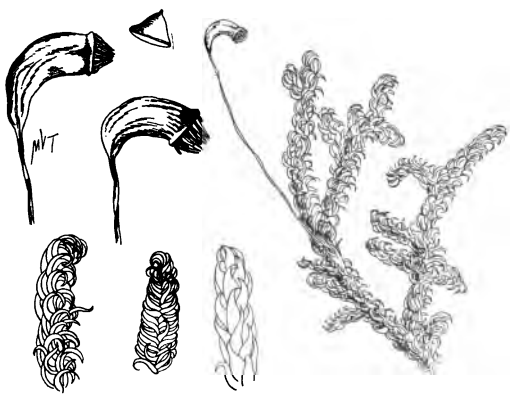

FIGURE 54. *Hypnum curvifolium* × 2; tips of branches × 4; and capsules × 4.

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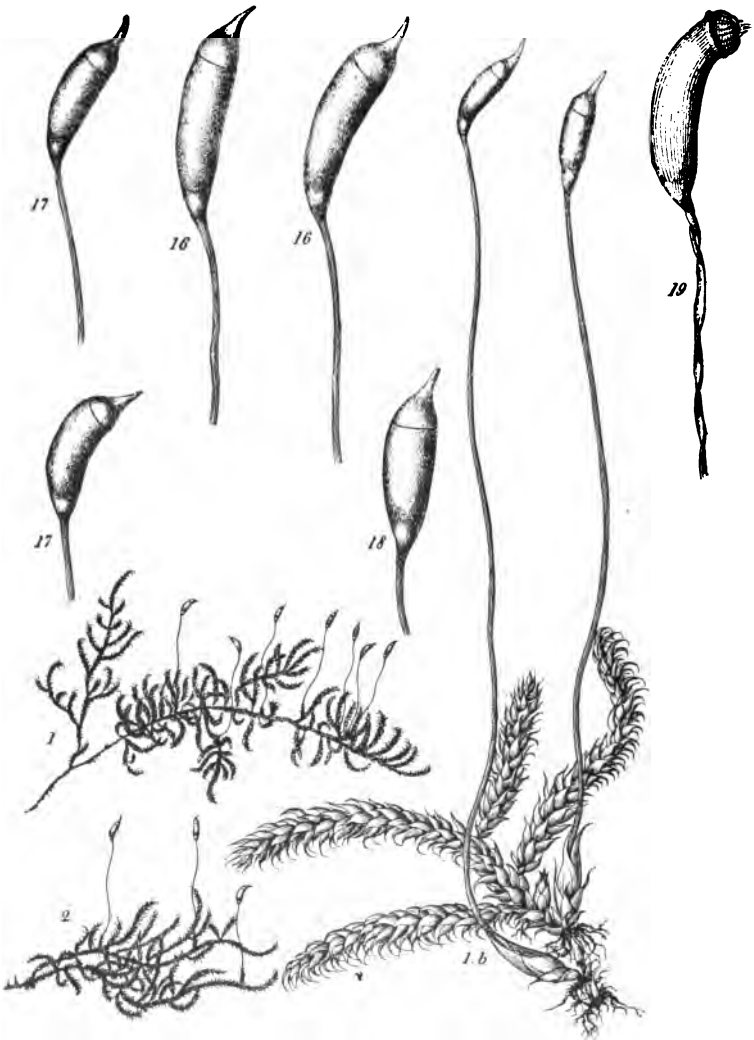

PLATE XXXII. *Hypnum reptile* (From Bry. Eur.). 1 and 2. Plants natural size. Erect capsules like 18 are rare. 19 does not show the mouth oblique enough to be typical.

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is often hard to separate the two. In this species, however, the branching is irregular and the leaves do not have the peculiar braided look of the preceding.

HYPNUM REPTILE Mx. is another regularly pinnate moss of this group, but it is less than half the size of the three described above. Its general appearance is also fairly well represented in Figs. 50 b, 51 b, but the capsules are longer and more curved. With a lens the leaves of the *Thuidium* will be seen to be acute and straight, while those of the *Hypnum* are curved and long acuminate. The *Thuidium* grows in thin mats so that its pinnate character is easily seen at a glance; the *Hypnum* grows in such densely interwoven mats that it is often necessary to disentangle it before its pinnate character becomes apparent. *Hypnum reptile* matures its capsules much earlier than any of the three other species mentioned above. They are usually fully ripe in August, and when dry and empty the mouth becomes oblique, almost as much so as in *Dicranella heteromalla.* Even if the capsules dry with the lid on, the mouth takes the oblique position strongly enough to be noticed. This obliquity of the mouth is not clearly shown in the figure.

AMBLYSTEGIUM ADNATUM (Hedw.) J. & S. is another species resembling *H. reptile* and often associated with it, especially on the bases of trees, but the leaves are not curved and the capsules are nearly straight and sub-erect.

H. HALDANIANUM Grev., the Common Hypnum, is almost sure to be found in any moist shady place where decaying wood is present, covering the unsightly masses of rotten wood with its upholstery of bright green. Occasionally it grows on soil rich in humus. It is one of our commonest mosses and nearly always fruits freely.

The Common Hypnum in appearance is very little like the species previously described; the leaves are straight and equally spreading on all sides, not secund. When mounted and examined with a high-power lens the abruptly enlarged cells at the basal angles are very conspicuous and render the determination certain. The capsules are cylindrical and somewhat curved, much like those of the Pinnate Hypnum, only larger. They mature in

PLATE XXXIII. *Hypnum Haldanianum* × 2; branch × 5; capsule × 10. 6, 7, 8, and 11. Leaves. 7b. Base of leaf showing enlarged cells at basal angles. 18. Paraphyllia (too small to be seen with the lens.) (Leaf drawings from Bry. Eur.).

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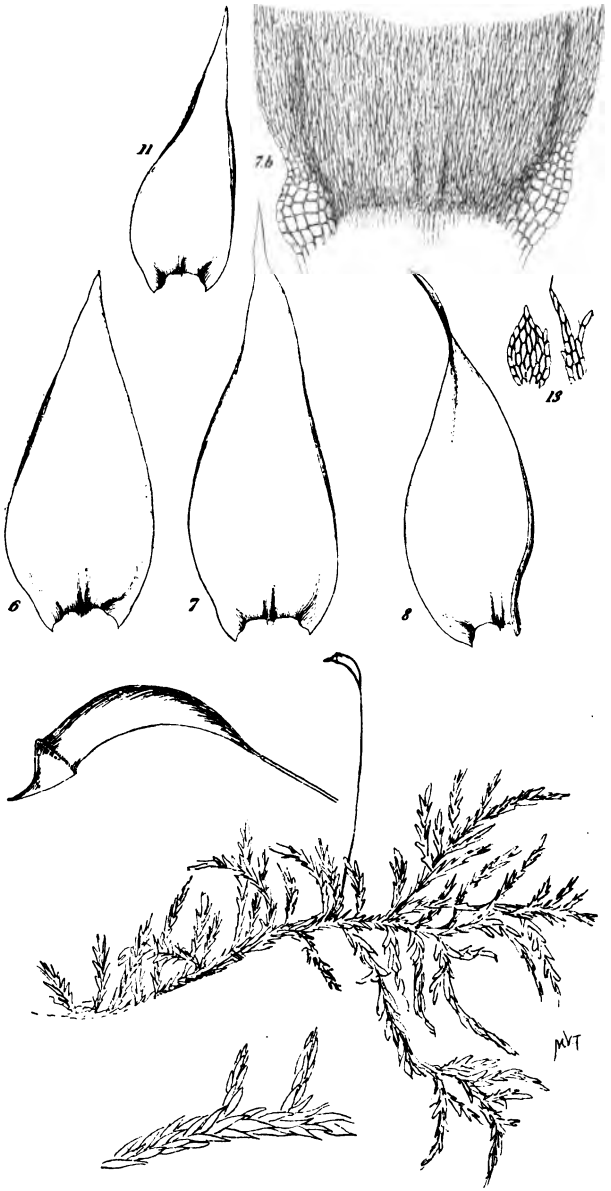

PLATE XXXIII. Explanation on preceding page.

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FIGURE 55. *Hypnum Schreberi* × ½.

late autumn or winter, but remain in fairly good condition until the next summer.

BRACHYTHECIUM OXYCLADON (Brid.) J. & S., the Long-capsuled Brachythecium, sometimes grows on decaying wood and then is scarcely to be distinguished from the Common Hypnum with certainty unless the leaves be examined with a high-power lens, when they will be seen to have a strong midrib, and no enlarged cells at basal angles. The capsules are usually much darker than those of the Common Hypnum. The usual habitat of the Long-capsuled Brachythecium is on moist ledges and rocks.

FIG. 56. Leaves of *Hypnum Schreberi*. (From Bry Eur.)

H. SCHREBERI Willd., Schreber's Hypnum, is the bright yellow-green moss that forms dense deep cushions by almost every moist shaded roadside in inland country regions. It is abundant in moist pastures and open woods, and sometimes makes its most luxuriant growth in a sphagnum bog. It is so common, so conspicuous, and withal so large, that every one must have noticed it at some time or other.

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The stems are often four to six inches long and nearly erect, and crowded so closely together as to form dense soft cushions into which the foot sinks deeply. Examined closely, the stems appear a bright red through the semi-transparent leaves.

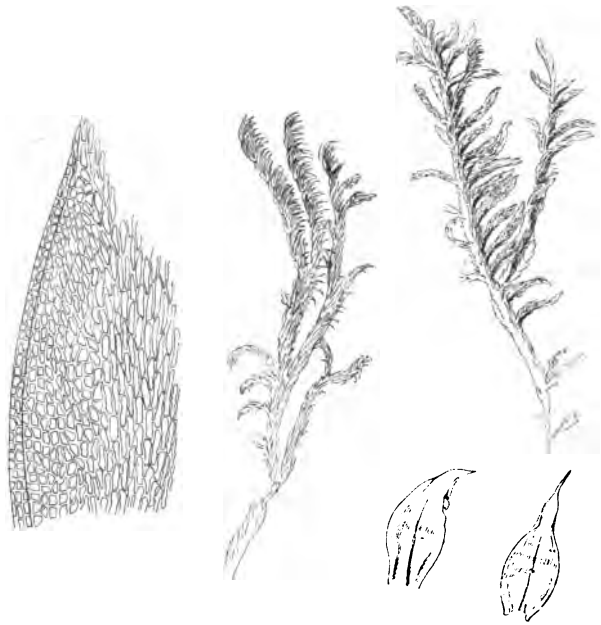

FIGURE 57. *Hylocomium rugosum.* Plants natural size; leaves × 5, and leaf cells.

Schreber's Hypnum has broad obtuse leaves incurved at apex and very concave, and is put by some botanists in a subgenus of Hypnum, by others in Hylocomium. The capsules mature in autumn; they are not as frequent as one would expect from the abundance of the plants.

HYLOCOMIUM RUGOSUM (Ehrh.) DeNot., Wavy Hypnum. When well developed this is one of the most striking of our mosses; the stems reach a length of four inches or more, and with the leaves are as thick as a lead pencil. The branching may be sparse and irregular or frequent and pinnate. The rather dense mats are usually bright glossy yellowish-green. The leaves are ⅛ inch or more in length, strongly falcate-secund,

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strongly wrinkled or undulate crosswise, with a single costa running 2-3 the length of the leaf. Small depauperate specimens may not be recognized at first sight, but the peculiarities of the leaves are well marked. It never fruits in this part of the world. Its favorite habitat is on bluffs.

HYLOCOMIUM TRIQUETRUM (L.) B. & S., the Shaggy Moss, is common on shaded banks that are neither extremely wet nor very dry. Its branches usually come out irregularly as illustrated in the figure and its leaves stand straight out from the stem, giving it its characteristic ragged appearance. Sometimes in moist mountain woods it branches regularly and grows to a height, or rather length, of five or six inches, so that one is with difficulty persuaded that it is the familiar moss of everyday acquaintance. The stems are very stout and stiff but elastic, or "springy." Because of this elasticity this moss is sometimes used for packing china and other brittle objects.

FIGURE 58. *Hylocomium triquetrum* × 1; stem leaf × 4.

Although the Shaggy Moss is common, its capsules are rather infrequent. They mature in winter or early spring; when dry they are often regularly furrowed with deep wide furrows. The leaves have two slender parallel nerves reaching about ¾ the length of the leaf.

HYPNUM CHRYSOPHYLLUM Brid., the Spreading-leaved Hypnum, is a moss common on soil, stones, bases of trees, etc., in shaded swampy places, and on wet cliffs. It is highly variable, but always has the leaves spreading at nearly right angles whether

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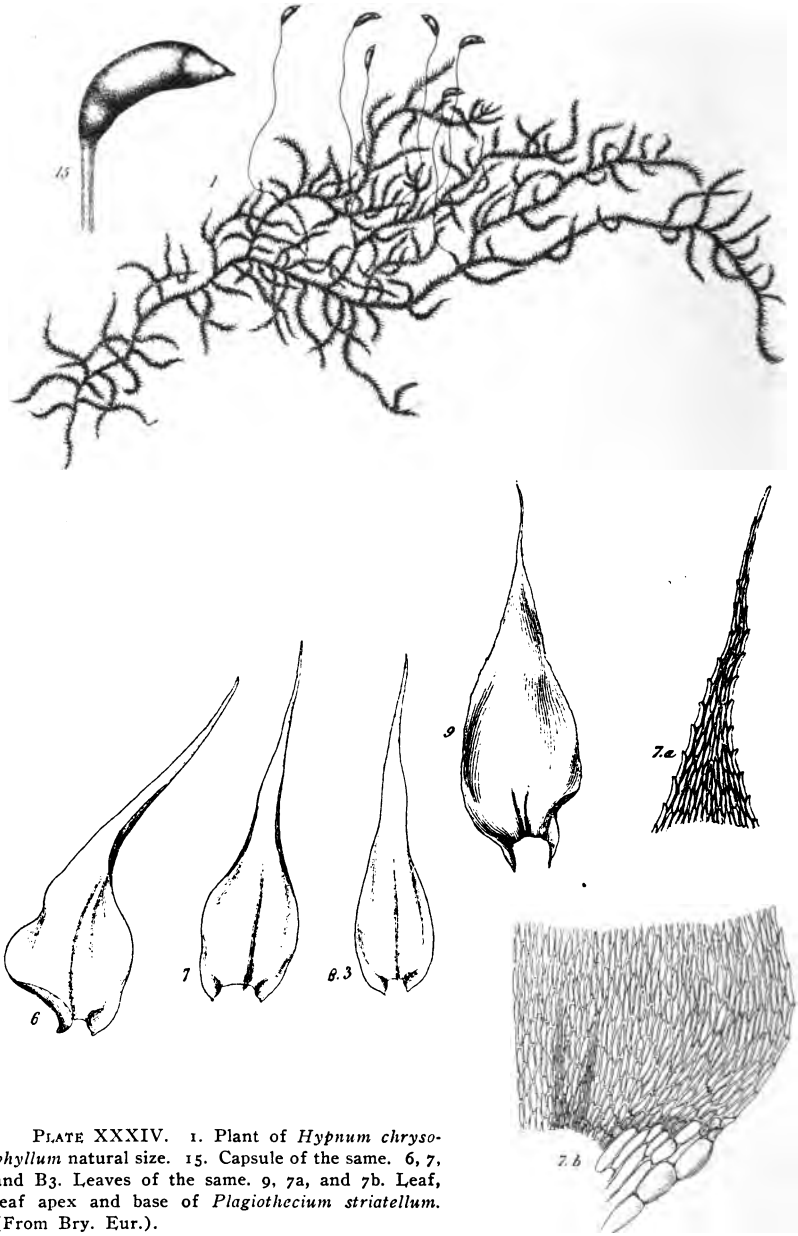

PLATE XXXIV. 1. Plant of *Hypnum chrysophyllum* natural size. 15. Capsule of the same. 6, 7, and B3. Leaves of the same. 9, 7a, and 7b. Leaf, leaf apex and base of *Plagiothecium striatellum*. (From Bry. Eur.).

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wet or dry. The plants are usually slender and creeping; the leaves are costate and of the shape shown in the figure. The capsules are not wrinkled and mature in late June.

PLAGIOTHECIUM STRIATELLUM (Brid.) Lindb., the Ribbed Hypnum, is another moss common in swamps and damp places, especially at the roots of trees and on peaty hummocks. The leaves are spreading as in the preceding, but the plants are much less creeping, the costa is absent, the capsule is plainly wrinkled when dry much as in *Hypnum curvifolium* (See Fig. 54), and at the basal angles are a number of inflated hyaline cells as shown in the plate. The spores mature in early May in the vicinity of New York City, where both this and the preceding species are common. The wrinkled capsules, spreading ecostate leaves, and early season of maturing spores make this an easy species to identify.

The Hooked Mosses.

Growing on stones, earth, and decayed wood in shaded swamps, edges of brooks, and shores of lakes and streams, will be found another type of Hypnum with strongly secund and hooked leaves. These mosses belong to the sub-genus Harpidium. As a

FIGURE 59. *Hypnum uncinatum* × 1; capsules × 10.

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rule the Hooked Mosses are much larger than the true Hypnums and are seldom or never regularly pinnate. The leaves at the end of the branches are specially noticeable for their hook-like appearance. Mounted and examined with a high-power lens, the leaves will be seen to have a well developed midrib, which at once distinguishes them from those of the true Hypnums.

The species of this subgenus are, perhaps, the most puzzling of any of the Hypnum Family and it is entirely useless to endeavor to enable anybody to distinguish the species without the use of a compound microscope.

HYPNUM UNCINATUM Hedw., the species figured, is the most common member of the subgenus. It is most frequently found on damp stones, more rarely on soil. The capsules are usually produced freely, maturing in autumn.

AMBLYSTEGIUM.

Most Amblystegiums are very slender creeping mosses with capsules which are often disproportionately large and which usually take the peculiar position shown in Fig. 60, 31 and 32, when dry. This peculiar shrinking is not always present; it is lacking in *A. adnatum* which has been treated in connection

FIGURE 60. Plants of *Amblystegium serpens* natural size and capsules much enlarged.

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with *Hypnum reptile*. Another species, *A. irriguum*, is treated in connection with the Water-loving Hypnums. The species as a rule are hard to determine without a compound microscope and only one other is included here, although we have a much larger number of common species.

A. SERPENS (L.) B. & S., the Creeping Hypnum, is common on soil and moist rotten wood in shaded places. As will be seen from the figures of the plants the leaves are almost too small to handle readily with forceps, but when mounted a well developed costa can be made out. The lens, however, will not show the cells.

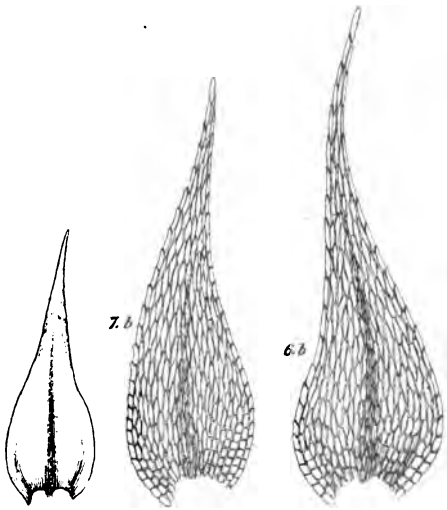

FIGURE 61. Leaves of *Amblystegium serpens*, highly magnified.

RAPHIDOSTEGIUM.

R. RECURVANS (Mx.) J. & S., the Common Raphidostegium, looks very much like one of the true Hypnums with irregular branching and secund ecostate leaves. It is a bright yellow-green and grows in dense mats on rotten stumps and logs in wet shaded places. It is common throughout our range, but I have rarely seen it in fruit in the vicinity of New York City. The chief distinction from the true Hypnums lies in the very short

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FIGURE 62. *Raphidostegium recurvans* × 2; capsules × 10.

capsules with lid very long beaked, and the enlarged alar cells like those of *Hypnum Haldanianum*. Until one becomes familiar with it, it is hard to recognize unless in fruit. The capsules mature in autumn and are often produced in great profusion.

The Water-loving Hypnums.

There are several species belonging to the Hypnum Family that grow on the stones in the bed of brooks, particularly in mountain regions. They do not belong to one genus, but their similarity of habitat, often combined with similarity in appearance, makes it easier to study them together.

Of the Water-loving Hypnums treated here four, *H. dilatatum, H. ochraceum, Rhynchostegium rusciforme,* and *Amblystegium irriguum,* grow on stones in brooks and are constantly submerged except at the very lowest water. *Brachythecium plumosum* is found on stones and soil wet by spray or submerged at high water, also in swampy places. *Brachythecium rivulare* may grow either in the water or alongside the stream or in very wet swamps. With the exception of *H. ochraceum* the four mosses growing in the water are almost black except the young growing tips of stems and branches.

RHYNCHOSTEGIUM RUSCIFORME (Neck.) B. & S., the Beaked Water Moss, is the coarsest, with broadly ovate costate leaves and strongly beaked capsules, which latter mature in September.

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FIGURE 63. *Rhynchostegium rusciforme* × 2; leaf and capsule × 10.

They are light colored and frequently produced in large quantities and present a very pretty appearance indeed against the dark background of the leaves.

H. DILATATUM Wils., the Round-leaved Hypnum, belongs to the subgenus *Hygrophypnum*. Its leaves are suborbicular and

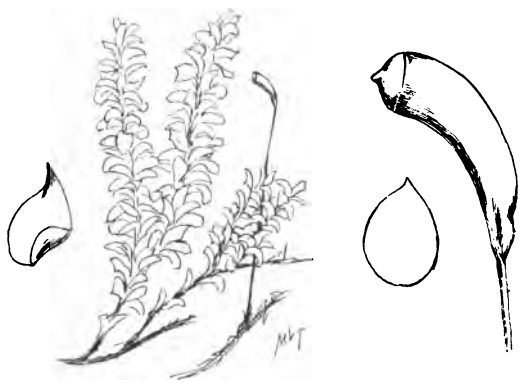

FIGURE 64. *Hypnum dilatatum* × 3; leaves and capsule × 10.

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ecostate. The capsules are not beaked. They mature in July according to Limpricht, but in autumn according to my observations. The Round-leaved Hypnum is frequent in mountain streams, but has formerly been referred to another closely related species (*H. molle* Dicks.), a much rarer moss with ovate-elliptical leaves.

There are several other species of *Hygrohypnum* that may be found in water. One of these (*H. ochraceum* Turn.) may be recognized by its yellowish or ochre-green color and strongly secund leaves narrowly obtuse at apex and having the costa short and double, or single and half the length of the leaf or more.

AMBLYSTEGIUM IRRIGUUM (Hook. & Wils.) B. & S. is a small moss very much smaller than any of the other Water-loving Hypnums. The leaves are strongly costate to the apex. The peculiarity of this moss is its harsh gritty feeling, which remains after being thoroughly washed. This is, perhaps, the blackest of the four submerged species. The capsules are in good condition in summer; when dry and empty they assume the characteristic Amblystegium pose shown in *A. serpens*, though they are smaller than in that species.

BRACHYTHECIUM.

The Brachytheciums, as previously stated (p. 114), are distinguished by their short thick unsymmetric cernuous capsules, and leaves with a well developed midrib. There are at least two species of Brachythecium that should be classed among the water-loving members of the Hypnum Family, although they are not so thoroughly aquatic as the two species just described.

B. RIVULARE B. & S., the Rivulet Brachythecium, loves best the wet gravelly soil at the edges of cool swift brooks. Frequently it will entirely cover the gravelly bottom of a mountain stream that is nearly dry during the summer. It is submerged at times of high water and never grows in places that become entirely dry; occasionally it will grow submerged, but even then it is attached to the gravel at the bottom of the stream and not to the stones as in the case of the two preceding species. When growing submerged the stems of the Rivulet Brachythecium become greatly elongated, slender and sparingly branched, with few and distant leaves. It is always much lighter colored than

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either the Beaked Water Moss or the Round-leaved Hypnum; the leaves are rather smaller, ovate and obtusely acute. The branch leaves are usually much smaller than the stem leaves, and are slenderly pointed. If the stem leaves be carefully removed and mounted the alar cells will be seen to be quite appreciably larger

FIGURE 65. *Brachythecium rivulare* × 1; leaf and capsules × 10.

than the others, although not so markedly so as in the Common Hypnum. The stems are often tall and stout, with a shrub-like habit. The capsules are not beaked and mature in autumn. If the seta be examined with a high power lens it will be seen to be covered with fine papillæ throughout.

B. PLUMOSUM (Sw.) B. & S. grows on rocks in the bed of brooks, but is not submerged except at high water. The difference in habit alone is sufficient to distinguish it from *B. rivulare;* it is much smaller, darker green, more closely applied to the substratum, nearly prostrate, with acuminate stem leaves. The seta is papillose in the upper portion only.

B. POPULEUM (Hedw.) B. & S. is a much more slender species growing on boulders, often near streams, but never on stones regularly submerged at high water. In this species the midrib runs to the very apex of the leaf, and the seta is papillose in the upper part only.

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PLATE XXXV. *Brachythecium plumosum* (From Bry. Eur.). 1 and 2. Plants natural size. 2, 3, and 4. Branch leaves. 5-9. Stem leaves.

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Two other species of Brachythecium are treated elsewhere (pp. 121 and 139).

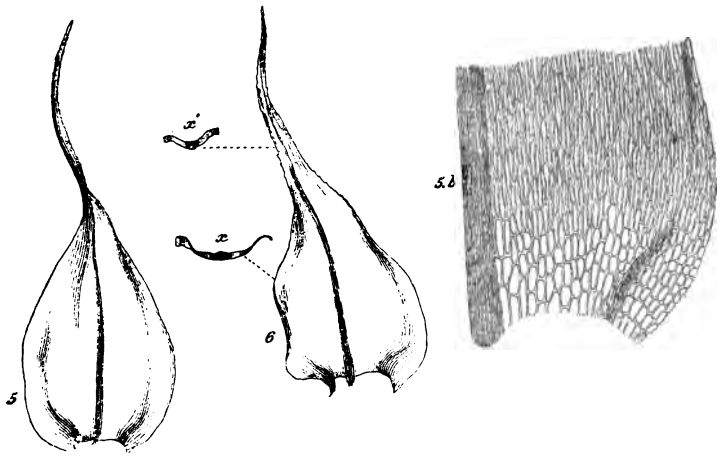

FIGURE 66. Leaves and leaf base of *Brachythecium populeum* (From Bry. Eur.).

The Beaked Mosses.

As has been previously stated, the Beaked Mosses (*Eurhynchium, Rhynchostegium,* and *Cirriphyllum*) are very closely allied to *Brachythecium,* differing mainly in the long-beaked operculum. One of these, the Beaked Water Moss, has already been described on page 129.

There are several species of Beaked Mosses that belong in the genus *Eurhynchium* that are fairly common, but it is doubtful if they can be accurately determined without the aid of the compound microscope.

EURHYNCHIUM HIANS (Hedw.) J. & S., the Light Beaked Moss, is very common on sandy soil in the lowlands. It is abundant in the public parks of Brooklyn, but rarely fruits there. It prefers damp places, not wet. The leaves spread so that the branches appear flattened in a horizontal plane. When fresh, the color is a peculiar shining light yellow-green. The branch leaves are usually bluntly acute. The capsules are produced sparingly, maturing in October.

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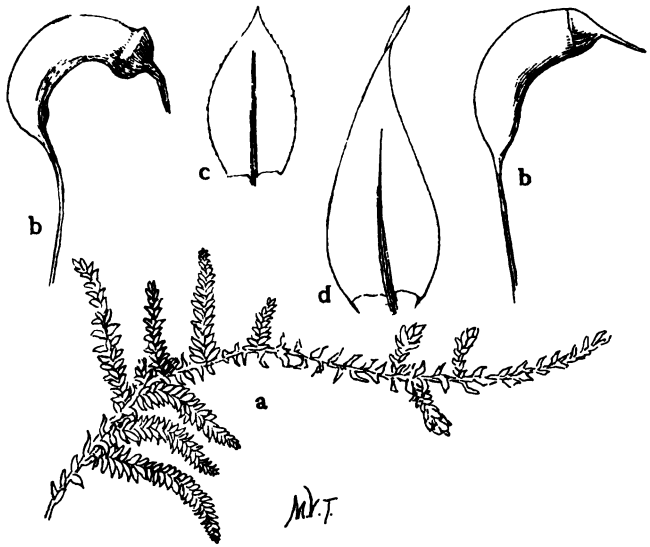

FIGURE 67. a. *Eurhynchium hians* × 2. b, b, Capsules × 10. c, Leaf × 20. d, Leaf of *Rhynchostegium serrulatum* × 10.

EURHYNCHIUM STRIGOSUM ROBUSTUM Roell., Common Beaked Moss. This species is common on the ground, roots of trees and decaying wood in cool woods, particularly on the sides of ravines. The plants are about the size of the preceding, but form closer mats, are a darker green, and are not flattened. The seta is smooth, while in *E. hians* it is very rough. One should not attempt to identify any of the Beaked Mosses for the first time unless the lids are on some of the capsules, for it can not be done with certainty.

RHYNCHOSTEGIUM SERRULATUM (Hedw.) J. & S., the Dark Beaked Moss, is found in a similar habitat, but has a more southerly and coastwise range, and is more likely to be found near the base of trees. It is also flattened, but is a rich green in color and the leaves are much longer and more slenderly acuminate, as shown in the figure. The seta is smooth.

CIRRIPHYLLUM BOSCII. (Schwaegr.) Grout, the Spoon-leaved Moss, is one of the Beaked Mosses that is easy to recognize when in its normal condition. It grows in fields among the grass

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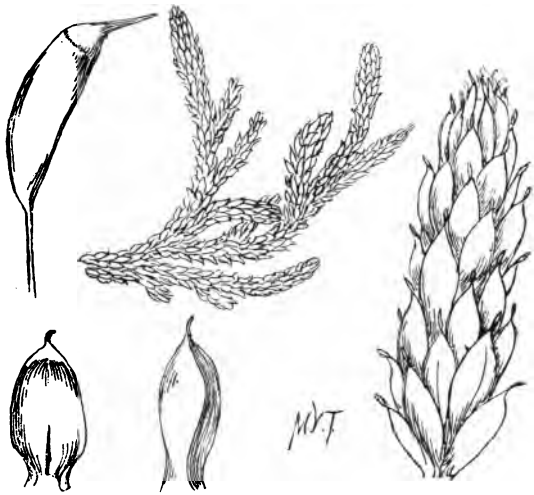

FIGURE 68. *Cirriphyllum Boscii* × ½; branch × 5; leaves and capsule × 10.

and on the ground in woods. Its leaves are very concave, being shaped much like the bowl of a spoon with a long twisted point added. The leaves are very regularly imbricated, making the branches turgid and very markedly julaceous, so that they look like little glossy yellow-green catkins. Although it gets as far north as southern Vermont, it is much more abundant southwards. It fruits sparingly, the capsules maturing in autumn.

PLAGIOTHECIUM.

The stems and branches of the Plagiotheciums grow close to that upon which the plant grows (substratum) and the leaves are apparently in two rows, giving the plants a flattened appearance like that of the Dark and the Light Beaked Mosses. They are readily separated from the Beaked Mosses by the fact that the Plagiotheciums have leaves without a midrib or else with a very short and double midrib. The capsules are also an aid, as they are long and slender like those of Hypnum proper. The species are numerous and difficult to determine.

There are two species everywhere present that may perhaps be recognized with the aid of a brief description and the accom-

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FIGURE 69. a, *Plagiothecium denticulatum* × 2. b, Three capsules of the same × 10. c, Capsules of *P. sylvaticum* × 10.

panying cuts. Both these species grow on humus in damp woods and shaded places; they grow at the base of trees and about rocks where there is a slight layer of humus for their nutrition.

P. DENTICULATUM (L.) B. & S., the Slender Plagiothecium, is more slender in habit and has nearly symmetrical suberect capsules with the lid not beaked.

P. SYLVATICUM (Huds.) B. & S., the Woodsy Plagiothecium, is generally a much coarser plant with larger, curved and cernuous capsules having a long-beaked lid. The capsules of both species mature in summer.

PYLAISIA.

Pylaisia affects the habitat of the Grimmia Family in that it grows on the bark of living trees. It is readily distinguished from the members of that family by being pleurocarpous, by the long exserted capsules, by the lighter green color, and by having the branches somewhat hooked at the end when dry. Old apple trees in rather dense orchards are a favorite habitat.

P. SCHIMPERI R. & C., the Common Pylaisia. (*P intricata* of most authors). It is also common on trees in the open woods and can be found on the shade trees of almost any of the smaller New England towns, but does not seem to thrive near the large cities. The plants grow closely interwoven and present the appearance represented in the figure only when disentangled. The erect subcylindric capsules mature in autumn.

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Pylaisia seems to be favored by most botanists in spite of technical objections, so *Pylaisiella* is dropped in this edition.

FIGURE 70. *Pylaisia Schimperi* × 10, wet and dry; leaf × 20; capsule × 10.

ENTODON.*

The Entodons have erect symmetric capsules, ecostate, very concave leaves and a beautiful glossy yellow-green color that enables one to recognize them without much trouble. The majority of the species are flattened, but have the appearance of being pressed flat instead of having the leaves apparently two-ranked as in Plagiothecium.

E. SEDUCTRIX (Hedw.) C. Muell., the Round-stemmed Entodon, is probably the most common species in the southern portion of our range. The stems and branches are round and julaceous with closely imbricated leaves. It grows on rotten wood, soil, moist rocks, bark of trees, etc.

E. CLADORRHIZANS (Hedw.) C. Muell., the Flat-stemmed Entodon, is nearly always found on decayed wood, rarely on soil rich in humus. Its strongly flattened stem and branches easily distinguish it from the Round-stemmed Entodon. This character, together with the peculiar color characteristic of the genus, will differentiate it from species belonging to other genera. There are a number of other American species of Entodon that resemble the Flat-stemmed Entodon, but they are rare and not likely to be met with. The leaves of both species are very concave, but those of the Flat-stemmed Entodon are larger. Both species mature their capsules in autumn or early winter.

**Entodon* C. Muell = *Cylindrothecium* B. & S.

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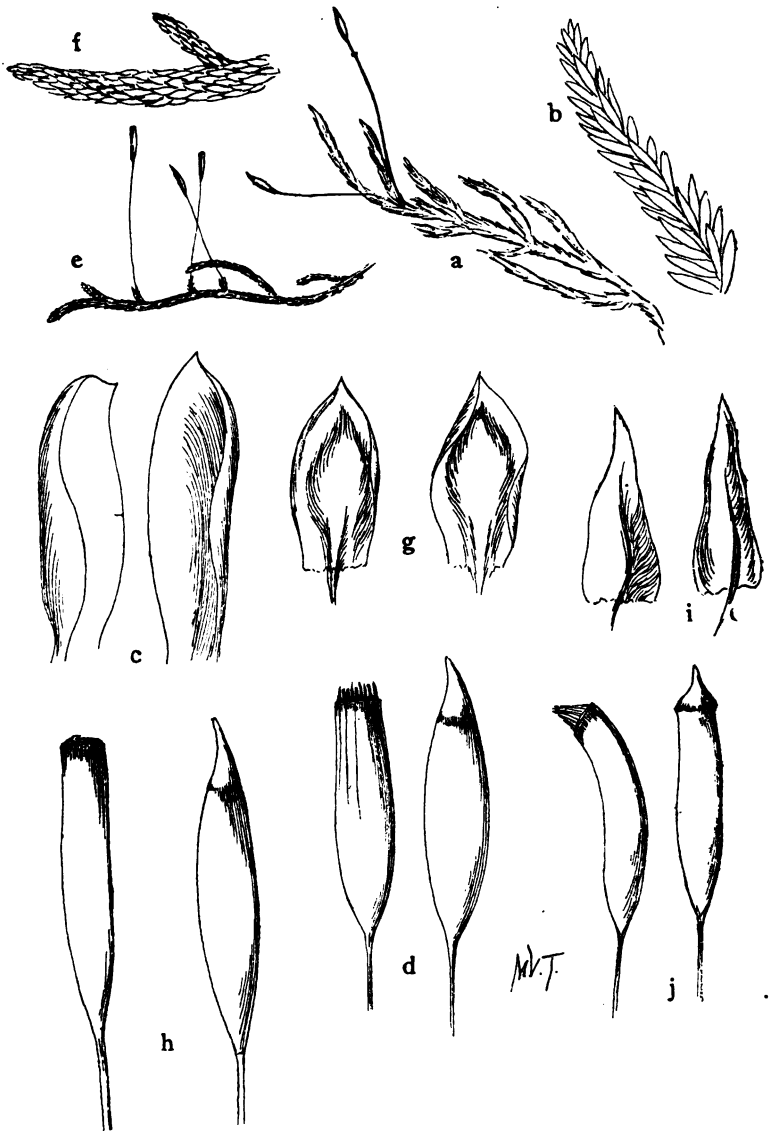

PLATE XXXVI. Explanation on next page.

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B. ACUMINATUM (Hedw.) Kindb., the Erect Brachythecium, is often mistaken for the Round-stemmed Entodon. It has a similar habitat and very nearly the same range. It also has julaceous light-green branches and erect symmetric capsules. A careful examination of the leaves will enable one to decide at once to which of the two any given specimen belongs. The leaves of the Brachythecium are somewhat smaller, scarcely concave, ovate-lanceolate and gradually acuminate, and strongly costate. The Erect Brachythecium is an anomaly in the genus and it and its allies should probably be placed in a separate genus. It is not related to Entodon, but is treated in connection with it because of its similarity in appearance. Its capsules are occasionally somewhat curved. They mature in autumn.

CLIMACIUM. The Tree Mosses.

The Tree Mosses are perhaps the largest of the pleurocarpous mosses. They are very markedly tree-like in habit and this, together with their size, has always brought them to the notice of those accustomed to country life. They are often mistaken for small forms of the Running Pine (*Lycopodium*). These mosses are common in moist or wet soil, particularly in wooded swamps, where their favorite habitat is around the bases of stumps, trees or other similar elevations. They are also found in moist grassy places, but rarely fruit in the latter habitat, and infrequently in the former. The erect tree-like shoots grow from stolons that are partially or wholly under ground. These continue to grow horizontally, producing new shoots each year.

C. DENDROIDES (L.) Web. & Mohr., the European Tree Moss, and

C. AMERICANUM Brid., the American Tree Moss. The leaves of the American Tree Moss are usually much more closely appressed when dry and are much more conspicuously auricled; its capsules are nearly twice as long as those of the European Tree Moss. Both species mature their capsules in autumn. The European Tree Moss is a native of America as well as of Europe,

PLATE XXXVI. a. *Entodon cladorrhizans* × 1. b. Branch × 5. c. Leaves × 20. d. Capsules × 10. e. *E. seductrix* × 1. f. Branch × 5. g. Leaves × 20. h. Capsules × 10. i. Leaves of *Brachythecium acuminatum* × 20. j. Capsules of the same × 10.

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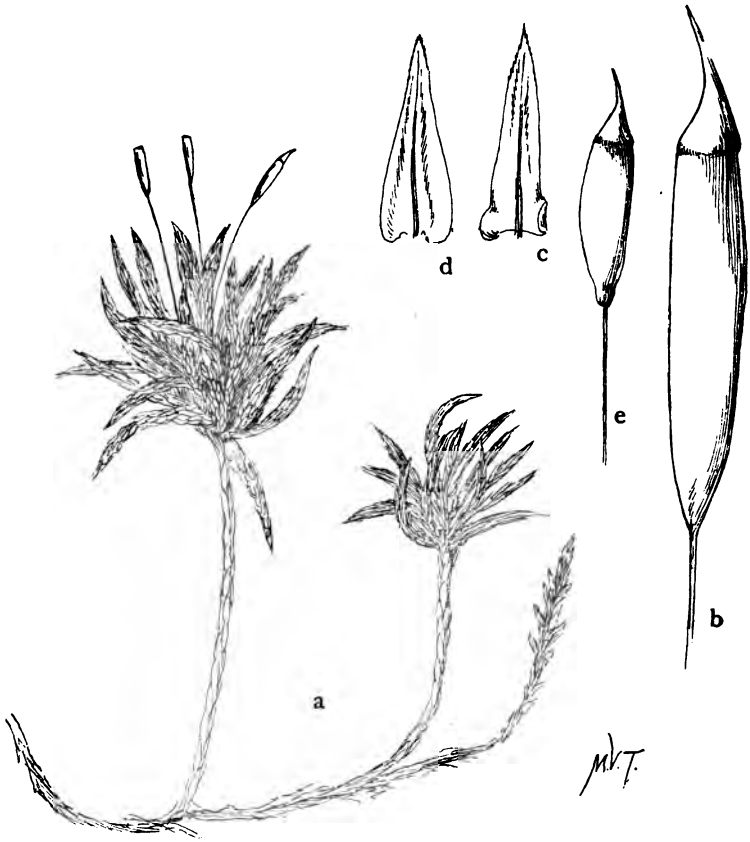

FIGURE 71. a, *Climacium Americanum* × 1. b, Capsule × 10. c, Branch leaf × 10. d, Branch leaf of *C. dendroides* × 10. e, Capsule of the same × 10.

but it was first described from the Old World. It is more common northwards, while the American Tree Moss is more common southwards. Both species are common in New England.

C. KINDBERGII (R. & C.) Grout, a third form of the Tree Mosses is common in swamps in the southern portion of our range. It grows close to the water and often down into it. It is prostrate or creeping, and rarely, if ever, assumes a tree-like

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habit. It has previously been called a variety of the American Tree Moss (*C. Americanum* var. *Kindbergii* R. & C.), or Kindberg's Tree Moss. It is named after Dr. N. Conrad Kindberg, of Linkoeping, Sweden, who has determined Prof. Macoun's Canadian Mosses. This form is very abundant in the swamps of Long Island. It looks like a very coarse Hypnum with large erect symmetric capsules. It fruits freely, the capsules maturing in early autumn.

LEUCODON.

The various species of Leucodon grow almost exclusively on the bark of deciduous trees; very rarely are any found on dry rocks. The Leucodons are seemingly able to do without moisture for considerable periods, as they rarely or never grow at the base of trees, but at a height of five or six feet and above. The main stems are long, slender, branching, almost filiform, with minute leaves and abundant rhizoids. The branches are numerous, suberect, horizontal, or hanging downward and curved outward, usually julaceous and nearly simple. The leaves are concave, with margins recurved below, ecostate, entire, closely appressed when dry, spreading when moist. The calyptra is cucullate, often attached below the capsule by the clasping base. The capsules are exserted or emergent, erect and symmetrical; peristome apparently simple, teeth 16, bifid or occasionally trifid; inner peristome reduced to a narrow inconspicuous membrane.

We have three species, only one of which, *L. sciuroides*, is European. There is considerable difference of opinion as to what other genera of mosses should be grouped with Leucodon. More careful study of its development and structure is needed to determine whether its natural relationship is with the Neckeraceæ or the Hypnaceæ.

L. JULACEUS (Hedw.) Sulliv., the Southern Leucodon. This species is typically southern, extending north to Southern New England and corresponding latitudes of the Eastern United States. The secondary stems are typically shorter than in the other two species, the branches very round and julaceous when dry; the leaves closely appressed and imbricate, not at all secund, ovate-elliptical, *abruptly short acuminate*, very concave and scarcely plicate. *Capsule long exserted as in L. sciuroides;* teeth bifid at apex.

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Easily recognized by its perfectly round stems and smaller, scarcely plicate, abruptly acuminate leaves.

L. SCIUROIDES (L.) Schwaegr. Forming tufts or mats of brownish green, lighter green at the tips of the secondary stems, which are terete and julaceous, more or less drooping and curved upwards at the ends, rarely 2 inches long, usually not over 1 inch, frequently producing such a great number of *flagelliform small-leaved branches as to cause the plant to appear deformed.* Leaves of branches slightly secund, ovate-lanceolate, somewhat decurrent, very long and slenderly acuminate, entire, plicate with several folds. Seta about ½ inch long; capsule exserted; teeth entire or split toward the base. Very rarely fruiting.

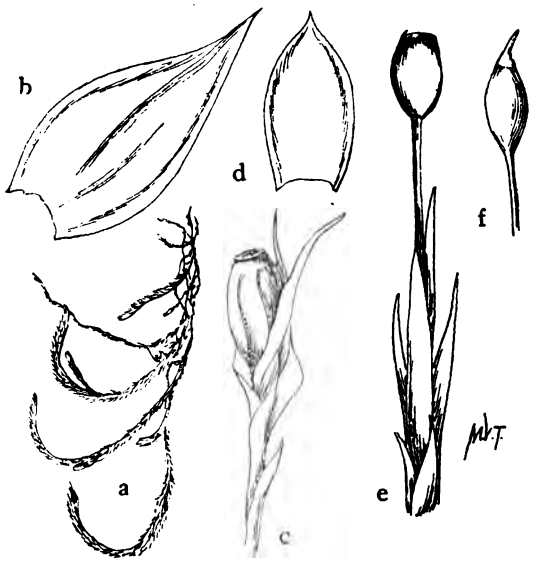

FIGURE 72. a, *Plant of Leucodon brachypus* × 1. b, Leaf of *Leucodon brachypus* × 20. c, Sporophyte of *Leucodon brachypus* × 10. d, Leaf of *Leucodon julaceus* × 20. e, Sporophyte of *Leucodon julaceus* × 10. f, Capsule of *Leucodon julaceus* × 10.

This is distinguished from *L. julaceus* by the different shape of its leaves. It fruits so rarely that it has to be differentiated from *L. brachypus,* which it closely resembles, by

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its leaf apices and flagelliform branches. The secondary stems are also much shorter than those of well developed *L. brachypus*. Probably common in Northeastern United States and Eastern Canada, but not often collected or else confused with *L. brachypus*. Collectors should be on the lookout for it.

L. BRACHYPUS Brid., the Northern Leucodon. The branches average longer and larger than in the preceding species, less frequently branched. *Leaves more strongly secund,* plicate, but with fewer folds than in *L. sciuroides;* the apex is not nearly so slender and pointed as in *L. sciuroides.* The seta is $\frac{1}{8}$ inch long, wrapped up in the perichætial leaves, *which over-top the emergent* capsule; teeth bifid at apex. The spores mature in winter.

This has about the same range as the last, but extends farther south. Abundant and frequently fruiting in the mountain regions of Northeastern United States. It extends to Georgia along the mountains, but is rare south of New York.

FAMILY 20. NECKERACEAE. The Neckera Family.

NECKERA.

N. PENNATA (L.) Hedw.,* the Feathery Neckera, is found almost exclusively on the trunks of deciduous trees in cool

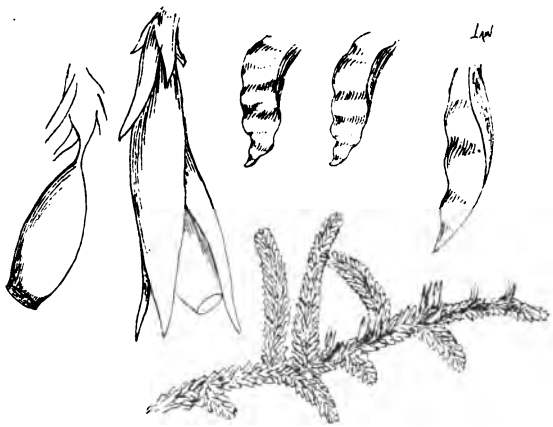

FIGURE 73. *Neckera pennata* × 1; leaves × 10; capsules, with and without perichætial leaves × 10.

*The only species likely to be met with in our range.

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moist woods, rarely on ledges or cliffs in similar situations. Neckera rarely grows near the base of a tree, nearly always growing well above that portion of the trunk occupied by Anomodon or Leskea, and extending upwards to a height of from twenty-five to fifty feet, according to the size of the trees and the density of the wood. Neckera is clearly characterized by its flattened branches, having wavy leaves, and its immersed capsules pendent from the lower side of the branches. The branches usually extend out from the tree trunk at an angle of from 45 to 75 degrees. The capsules are produced on the older portions of the plant, often in great numbers. They mature in summer.

HOMALIA.

HOMALIA TRICHOMANOIDES (Schreb.) B. & S. var. JAMESII (Scimp.) Holz. Homalia is a very pretty moss frequent on moist rocks in the mountains. I do not find it fruiting freely, but it is easily recognized by its flattened branches which look like a Fissidens or an hepatic. A close examination readily shows that it is neither, as the leaves are not double at base, and the midrib is well developed. A favorite place of Homalia is the underside of overhanging rocks at the base of ledges in cool moist ravines, where it often grows in single strands, the pendent and flattened branches producing a very pretty effect.

FAMILY 21. FONTINALACEAE. Water Moss Family.

ALTHOUGH mosses belonging to several other families are aquatic, the mosses of this family are most emphatically entitled to the name of Water Mosses. By some the scientific name is translated more exactly, and they are called the Fountain Mosses. The members of the family are either submerged all the time or attached to objects that are submerged at some seasons of the year. They are very dark and usually slender. The midrib is present in Dichelyma, but lacking in Fontinalis. The seta is usually short and wrapped up in the perichætial leaves. The peristome is double, the inner forming a regular net through the meshes of which the spores gradually escape.

PLATE XXXVII. *Homalia trihomanoides* (From Bry. Eur.). 1. Plants natural size.

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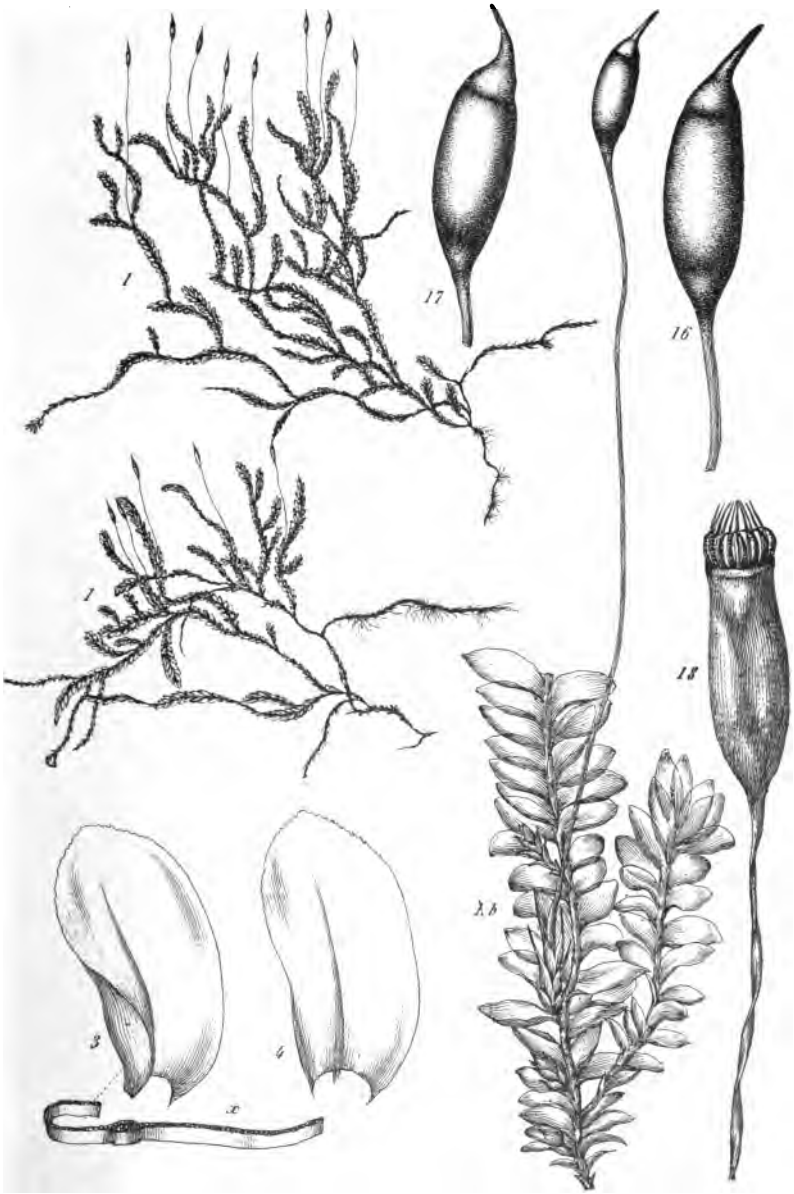

PLATE XXXVII. Explanation on preceding page.

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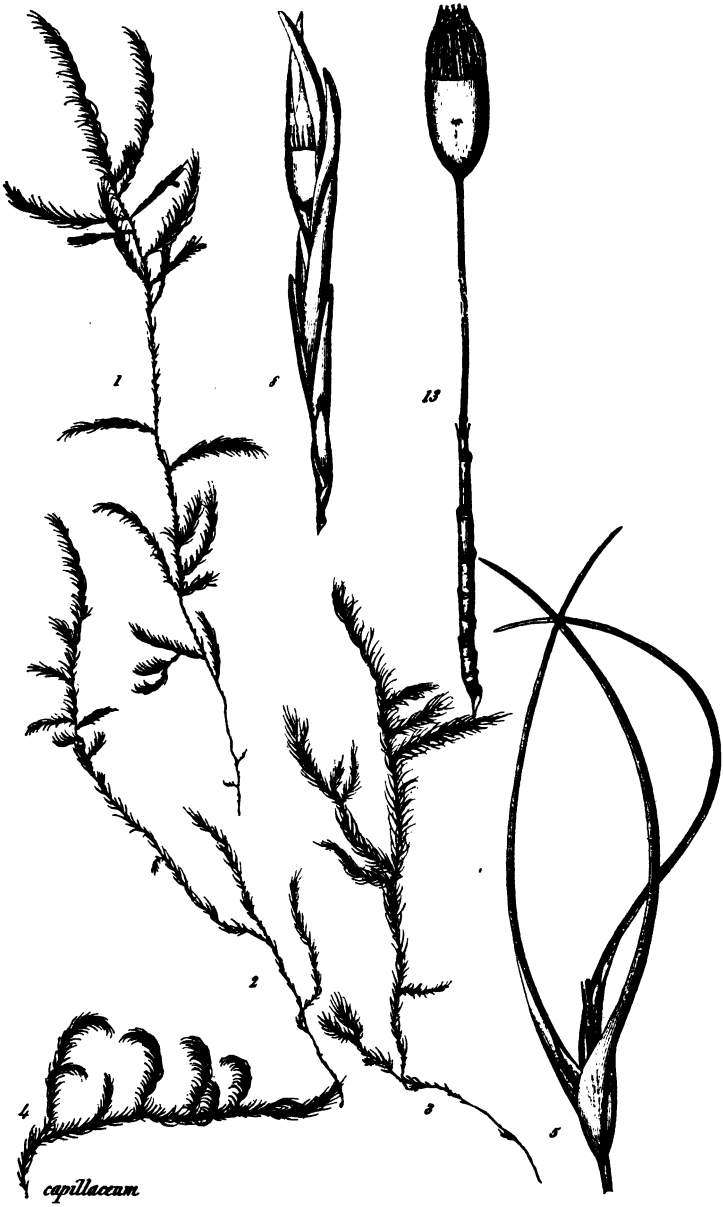

PLATE XXXVIII. Explanation on the next page.

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DICHELYMA.

D. CAPILLACEUM (Dill.) B. & S. is usually found attached to the stems of bushes that grow in swamps and on the edges of ponds. The stems of Cephalanthus are favorite attachments. The plants are not so long as in Fontinalis, and the branches are usually curved at the ends as shown in figure 4 of the plate. The leaves are very long and narrow and the costa stout and excurrent. The capsules are much like those in Fontinalis. The spores mature in late summer.

FIGURE 84. Branch of *Fontinalis dalecarlica.*

FONTINALIS. The Water Mosses.

In the genus Fontinalis all the species are aquatic and submerged. Some grow attached to stones and sticks in swift brooks. Others are found attached to objects in ponds and sluggish streams. Rarely, if ever, are they found in stagnant water. The Water Mosses are so distinct from all others in their long slender floating stems and branches that no one can fail to recognize them. The species are, however, very difficult to determine, with two or three exceptions.

FONTINALIS GIGANTEA Sulliv., the Giant Water Moss, is common in cool brooks and is most distinct by reason of its large turgid three-cornered stems and branches. The branch shown in the plate is a very short one; the branches are

PLATE XXXVIII. *Dichelyma capillaceum* (From Bry. Eur.). 1-4. Plants natural size.

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sometimes a foot or more long. The Giant Water Moss rarely fruits.

FONTINALIS DALECARLICA B. & S., the Common Water Moss, is everywhere abundant and usually fruits freely, the capsules maturing in summer. As will be seen from the plate, the capsules are almost entirely covered by the perichætium and are borne on the older portions of the plant from which the leaves have fallen. One must not be too sure that he has found this species until he has studied it with a compound microscope, as there are several other common species that are not readily distinguished from it.

This last statement has particular force from the fact that the branch figured in b, plate XXXIX, is not *F. dalecarlica* as was stated in the FIRST EDITION, but

F. NOVAE-ANGLIAE Sulliv., which was collected from the same brook and almost intermingled with *F. dalecarlica* which was figured natural size in the same plate. The figure of a branch of *F. dalecarlica* from the Bryologia Europea will enable one to distinguish the two species in most cases.

PLATE XXXIX. a, *Fontinalis dalecarlica* × ½. b, Branch × 5 of *F. Novae-angliae*. c, Portion of plant bearing capsules × 5. d, A short branch of *F. gigantea*.

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PLATE XXXIX. Explanation on preceding page.

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HEPATICAE. Hepatics.

THERE has been a considerable demand for a simple book on the hepatics. To meet this demand I have prepared this treatment of the subject. With the Queen ¼-inch achromatic triplet I am able to make out the more minute structures mentioned in the keys. Many of them, especially leaf structure, can not be made out satisfactorily unless the objects be mounted in water on a slide in the same manner as for a compound microscope.

In working up the key I have been surprised to find that sterile hepatics are, as a rule, much easier to identify than sterile mosses. Many of the species maturing their spores in early spring have the spores and capsules pretty fully developed in the preceding autumn so that some of the sporophyte characters are nearly always accessible. Hepatics shrivel more than mosses in drying and are best studied while fresh, especially the thalloid forms.

A few of the rare genera are omitted and some of the minute or difficult species are not included.

The Germans call the true mosses *Laubmoose,* meaning leafy mosses, and the hepatics, *Lebermoose,* or liver mosses. The name Liverwort was originally applied to Marchantia because of its fancied resemblance to the liver. Because of this resemblance it was supposed to be a specific for all liver troubles according to the old doctrine of signatures. From this came the Latin name *Hepaticae* and the German *Lebermoose.* "Thus does the language of ignorant superstition become the adopted language of science."

The chief distinctions between mosses and hepatics have been noted in the introduction, but a few additional notes here may prove helpful.

The hepatics may be leafy stemmed and appear much like mosses, or they may consist of a broad, flat and rather thin plant body (thallus) which is usually closely applied to the substratum. These thalloid hepatics might be mistaken for some of the foliaceous lichens, but the hepatics are always much greener and produce spores in a very different manner. Hepatics generally grow in moist situations on soil, roots of trees, and decaying wood.

In the leafy-stemmed hepatics, often called Scale Mosses, the

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leaves are without midrib and are nearly always in two ranks and usually flattened so as to lie in one plane, but in the great majority of cases there is a third rudimentary row on the under side which are called underleaves, or amphigastria by those devoted to technical names. The pedicel which corresponds to the seta of the mosses does not, as a rule, grow much until the spores are nearly ripe, when it elongates very rapidly. The pedicels and capsules are of a much more delicate structure than in the mosses so that they disappear soon after the spores have escaped, but the peculiar and characteristic scales or bracts around the base of the pedicel often remain much longer and help greatly in identifying species. Immediately surrounding the base of the pedicel is a tubular, somewhat three-sided organ called the inner involucre or perianth, surrounding this is the outer involucre, called simply involucre by many authors. This latter may be either tubular or composed of separate leaf-like divisions of varied shapes, called involucral leaves or bracts, or perichaetial leaves or bracts, or simply bracts. Either one, or even both, of these involucres may be lacking in some species.

So far as possible gametophyte characters have been used in the keys and descriptions and in the great majority of cases identification is easy from this part of the plant alone.

Owing to the difficulty of getting authentic material in condition suitable for use in making drawings, many drawings have been borrowed from various sources to illustrate plants that would otherwise have been illustrated with original work.

KEY TO FAMILIES.

Plants leafy, mosslike in appearance except for the two-ranked leaves with midrib entirely lacking.....Scale Mosses *(Jungermanniaceae)*.
Plants consisting of a flattened green thallus, sometimes nearly circular but usually elongated and branching. (See illustrations of Riccia, Marchantia, Anthoceros, etc.).....A.

A

1. Capsules, if present, immersed in the tissue of the plant. Plants floating on the surface of still water or growing on the mud along the banks.....Riccias (*Ricciaceae* in part).
   Capsules raised well above the thallus. Plants often growing in mud but never floating .....2.
2. Stomata (in our genera) present, easily discernible with a lens as small pores on the upper surface of the rather thick thallus; capsule borne on a special stalked receptacle as in Marchantia .....Liverworts *(Marchantiaceae)*.
   Stomata not present on the thinner thallus; capsules never borne on a special stalked receptacle.....3.
3. Capsules usually very long and slender, splitting into two valves when ripe after the manner of a mustard pod, the slender hairlike columella remaining in the center. Horned Liverworts *(Anthocerotaceae)*.
   Capsules globular or ovoid, splitting into four valves; columella lacking.....Thalloid Scale Mosses *(Metzgeriaceae)*.

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RÍCCIA.

Two of our Riccias included here are readily recognized by reason of their floating habit, in spite of the fact that the capsules are rarely observed.

R. FLUITANS L., the Slender Riccia, consists of a very thin slender floating thallus, repeatedly forking (dichotomous) and often intertangled so as to form small mats. The thallus is very narrow, $\frac{1}{24}$ to $\frac{1}{8}$ inch in width and from ½ to 2 inches long. Floating, it has no roothairs but it frequently is left on muddy banks where it sends out numerous roothairs into the soil. Rather rare.

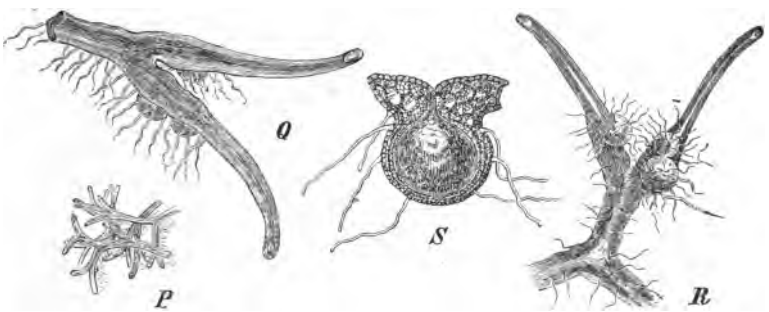

FIGURE 75. *Riccia fluitans* (After Bischoff.) P. Plants natural size. Q. Portion of the thallus with fruit seen from above. R. The same seen from below. S. Cross section of frond through imbedded capsule.

RICCIOCARPUS NATANS (L.) Corda, the Purple-fringed Riccia, is a very different looking plant with its branches obcordate or wedge-shaped, ¼ to ½ inch long and nearly as broad. There is a strongly marked furrow along the middle of each branch and an abundance of slender purplish scales underneath. The stomata are large and easily seen with a hand-lens. Frequent in stagnant ponds.

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ANTHOCEROTACEAE. The Horned Liverworts.

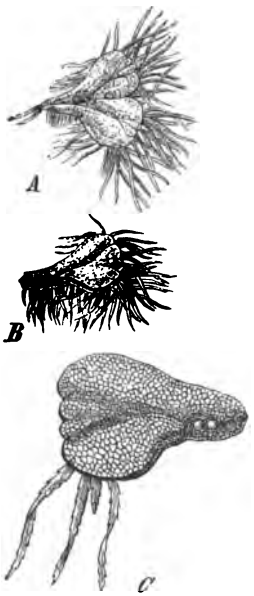

FIGURE 76. *Ricciocarpus natans* (After Bischoff.) A & B. Plants natural size. C. The same enlarged.

It will be difficult for the beginner to recognize the Horned Liverworts without capsules, but with a compound microscope they are easily known by the single large chlorophyll grain in each cell.

This character is very plainly seen with the high power hand-lens, the whole tissue of the thallus appearing filled with large green balls, quite unlike the diffused green of other plants. In fruit, the peculiar capsule, which is responsible for the common name, is unmistakable. It splits into two halves like a mustard pod and the columella remaining in the center increases the similarity.

ANTHÓCEROS.

We have two species that are fairly common on moist soil and are often found growing together.

A. LAEVIS L., the Yellow Spored Anthoceros, is known by its brownish or yellowish capsules and yellow spores.

A. PUNCTATUS L., the Black Spored Anthoceros, has both capsules and spores black. The spores of both species mature in autumn (Sept.-Oct.).

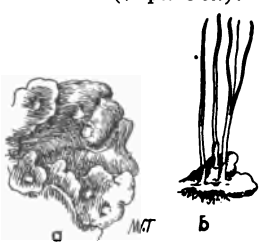

FIGURE 77. a, Sterile and b, fertile thallus of *Anthoceros punctatus* × 2 & 1.

NOTOTHÝLAS.

N. ORBICULARIS (Schwein.) Sulliv., which might be called the Short-horned Liverwort, is like Anthoceros except for the very short capsules which are exserted only a little way and split only half way down. The thallus is ¼ to ¾ of an inch in diameter; capsules $\frac{1}{12}$ to $\frac{1}{8}$ inch

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FIGURE 78. *Notothylas orbicularis* (After Sullivant.)

in length; spores light yellowish-brown, maturing in autumn. Widely distributed but apparently not abundant.

The Horned Liverworts are the highest of the Bryophyta and by many are considered as the ancestors of the Ferns, but they are put here for convenience, as they are sure to be sought with the other thalloid hepatics.

MARCHANTIACEAE.
The True Liverworts.

The plants of this family consist of a thallus of medium to large size, one-half to six inches in length, usually branching dichotomously but sometimes with more than two branches at a fork. They are attached to the substratum by numerous roothairs and are thickened in the middle to form a midrib. This in some cases is not very apparent above but shows plainly underneath. The upper surface is covered with small pores (stomata) which are very apparent with a lens, except in Reboulia. The capsules are spherical or ovoid and open irregularly by imperfect valves or by a portion of the top coming off after the manner of a lid. In this family the capsules and usually the antheridia are borne on special long-stalked receptacles well illustrated by the familiar Marchantia.

KEY TO THE GENERA.

1. Sterile stems bearing abundant gemmæ in shallow open receptacles...2
   Sterile stems without gemmæ 3
2. Found only in and around greenhouses; gemmæ in crescent-shaped receptacles; never fruiting in our region.....*Lunularia.*
   Growing abundantly everywhere; gemmæ in cup-shaped receptacles; capsule-bearing receptacles with 7 to 11 conspicuous rays .....*Marchantia.*
3. Thallus large; 2 to 6 inches long and ½ inch or more wide, distinctly areolate as in Marchantia, but areolæ larger and hexagonal ..... *Conocephalum.*
   Thallus less than two inches in length and much less than ½ inch in width.....4
4. Pores (stomata) scarcely distinguishable; antheridia in sessile receptacles which might be mistaken for gemmæ-bearing cups; thallus purple on the margins; midrib strong underneath but not conspicuous above.....*Reboulia.*
   Pores conspicuous, white; antheridia in peduncled disk-like receptacles; thallus with numerous dark purple scales underneath ..... *Preissia.*
   Pores conspicuous; antheridia immersed in the thallus; thallus purple underneath, at least along the margins.....5

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5. Perianth conspicuous, split into 8 to 16 fringe-like lobes; peduncle not chaffy; plants with a noticeable odor.....*Asterella.*
Perianth lacking; peduncle chaffy at top and bottom.....*Grimaldia.*
(The Reboulia of this key is the Asterella of Gray's Manual and the Asterella is the Fimbriaria of that work.)

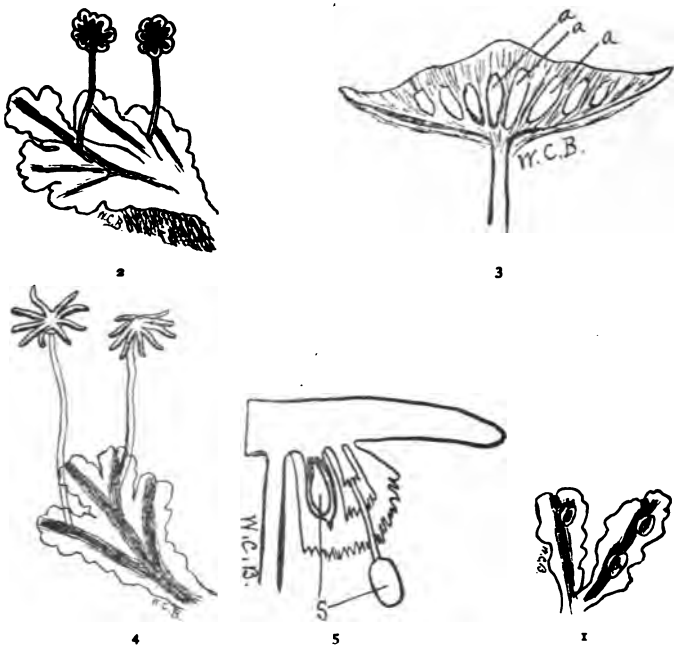

FIGURE 79. *Marchantia polymorpha.* 1. Sterile thallus with gemmae. 2. Male plant a little reduced, showing antheridial receptacles. 3. Longitudinal section of antheridial receptacle magnified. 4. Female plant reduced showing the stalked receptacles which characterize this family. These receptacles vary in the family from the shape shown in this figure to almost perfectly conical and entire. 5. Section of a part of a female receptacle magnified, showing two sporogonia. The seta of one has elongated, pushing the capsule out from the outer fringe (involucre) and the inner fringe (perianth). At the base of the seta is a little collar representing the base of the broken calyptra. (From BRYOLOGIST, 4:34-35, 1901.)

CONOCÉPHALUM AND MARCHÁNTIA.

C. CONICUM (L.) Dum. and M. POLYMORPHA L. are the only two species of this family common enough to be often collected by amateurs. They are both large, 2-5 inches or more in length, grow on moist banks, and are somewhat similar in

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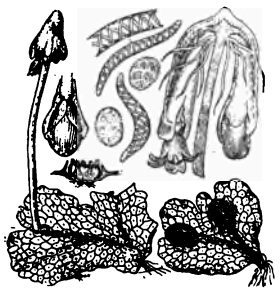

FIGURE 80. *Conocephalum conicum* (After Bischoff.)

appearance, but the surface of Marchantia is marked off into diamond shaped areas, called areolae, with a stoma in the center of each, while in Conocephalum the areolae are larger, and hexagonal in the center of the thallus to oblong-hexagonal on the margin, with the stoma so large as to be visible to the naked eye. Receptacles which bear the capsules are very different also as is shown by the figures. The capsules of Conocephalum mature in April, those of Marchantia in June and July. The stalked receptacles may assume their characteristic form much earlier.

LUNULARIA.

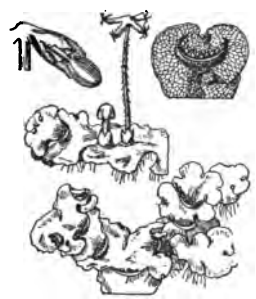

FIGURE 81. *Lunularia cruciata* (After Bischoff.)

L. CRUCIATA (L.) Dum. Any one who has ever had to do with green houses must have noted the beautiful green thalli of this plant. Small plants are sometimes mistaken for large fern prothallia, but the crescent shaped receptacles filled with gemmae are abundant on all the larger plants and render them easy of recognition. This plant is introduced from Europe and has but once been reported as fruiting in this country. (Bryologist, Sept., 1902.)

ASTERELLA.

A. TENELLA (L.) P. de Beauv. (*Fimbriaria tenella* Nees.) is fairly common on damp earth. The sterile fronds are often dichotomously branched and reach nearly an inch in length. The thallus is purple on the margins and has purple scales under-

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neath. In fruit the fringed perianth is unmistakable. The spores mature in April and May.

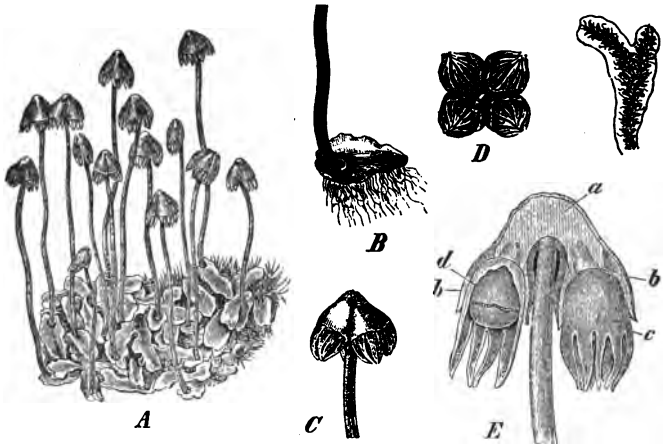

FIGURE 82. *Asterella tenella* (After Bischoff.) A. Group of fruiting plants natural size. E. Section through the fruiting receptacle. The other figures are self explanatory. The drawing at the right shows underside of thallus × 2.

PREISSIA.

P. QUADRATA (Scop.) Nees. (*P. commutata* of authors). The

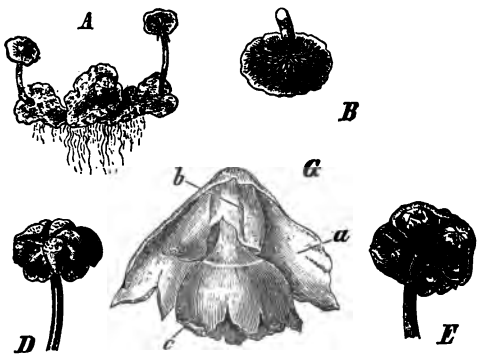

FIGURE 83. *Preissia commutata* (After Bischoff.) A. Antheridial plants natural size. B. Underside of antheridial receptacle. D & E. Fruiting receptacles. G. Perianth open; a, perianth; b, calyptra; c, capsule.

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thallus varies from 1-3 inches in length and also has purple margins and purple scales underneath. There are abundant raised pores all over the surface. The perianth is inconspicuous and on the upper surface of the female receptacles are ribs alternating with the lobes (four or less). The peduncle is at first covered with hairs which mostly disappear except at base and apex. The spores are mature in early spring. This species is perhaps most likely to be mistaken for Marchantia because of its large size and stalked male discs.

FIGURE 84. *Grimaldia fragrans* (After Bischoff.) part of male and female plants; section of male disk; female receptacle, etc.

GRIMÁLDIA.

G. FRAGRANS (Balb.) Corda (*G. sessilis* Sulliv.) is distinguished by the peduncle, hairy at base and apex; female receptacle without alternating ribs, and antheridia in a disk immersed in the apex of the thallus. The thallus also has purple margins and purple scales. Its spores mature in May, but in the autumn the spots from which the female stalk and receptacle develop are densely covered with slender white scales. forming a whitish spot visible for several feet. In Reboulia the scales are much fewer and are more like hairs.

FIGURE 85. *Reboulia hemisphaerica* (After Bischoff.)

REBOÙLIA.

R. HEMISPHAERICA (L.) Raddi. This species resembles Preissia in size and appearance, but is distinguished by its very small stomata, two toothed purple scales, and sessile dusky purple male receptacles. The spores mature in late autumn.

Like Grimaldia the thallus of Reboulia bears a number of white slender scales in autumn around the

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place from which the female receptacle will develop, but the scales are much fewer in number and are like hairs, while in Grimaldia they are $\frac{1}{25}$ of an inch or more wide.

METZGERIACEAE. The Thalloid Scale Mosses.

The spore bearing portion of plants of this family is like that of the Scale Mosses, but the green part of the plant is a thallus instead of a leafy stem in nearly all cases. There are, however, some intermediate forms in the family in which the thallus is divided into leaflike lobes. The thallus is much less highly differentiated than in the Liverworts and Riccias; there are no areolæ or pores (stomata), and the thallus is much thinner than in the Liverworts, in some species consisting of only a single layer of cells except at the midrib. The capsules are borne singly on setæ arising directly from the thallus. They are spherical to elongated-ovoid and remain enclosed in the calyptra until mature, when the setæ rapidly elongate and break open the calyptra which is left at the base of the seta. The capsules open by four valves as in many of the Scale Mosses. A careful search of wet bare earth in shaded or springy places will nearly always yield one or more species of this family.

KEY TO THE GENERA.

1. Thallus with a distinct midrib.....2
   Thallus without a distinct midrib.....4
2. Thallus $\frac{1}{16}$ to $\frac{1}{12}$ inch wide, dichotomously branched, ciliate along the margins .....*Metzgeria.*
   Thallus $\frac{1}{3}$ to $\frac{1}{2}$ inch wide, not ciliate at margins, entire or lobed 3
3. Thallus simple or only once forked, 1 to 4 inches long, prostrate; margins sinuate to entire; capsule ovoid-cylindric...*Pallavicinia.*
   Thallus dichotomously branched ¾ to 1½ inches long, often densely clustered and ascending, margins lobed; capsules spherical without perianth, appearing buried in the midrib for some time before the ripening of spores (Fig. 88).....*Blasia.*
4. Thallus pinnately or palmately branched, $\frac{3}{4}$ to $\frac{1}{12}$ inch wide (except *R. pinguis*).....*Riccardia.*
   Thallus subsimple or dichotomously branched, ⅛ to ⅓ inch in width (Fig. 90).....*Pellia.*

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METZGÈRIA.

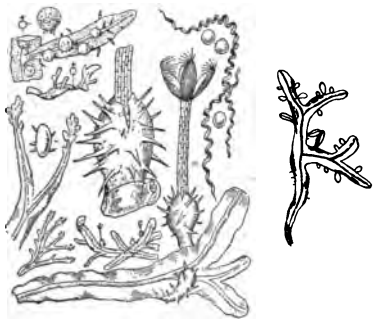

FIGURE 86. Plants (male, female and gemmæ-bearing) of *Metzgeria furcata* (After Hooker.) The smallest plants are rather larger than natural size. So far as the drawings go they represent our *M. conjugata* equally well except the plant bearing gemmæ. The drawing by Miss Thayer at the right shows the gemmæ along the sides of the thallus of *M. conjugata* × 5.

M. CONJUGATA Lindb. is the only Metzgeria likely to be found. It is apparently not common but will be easily recognized by its narrow ($\frac{1}{25}$ inch) thallus dichotomously branched, with very distinct midrib. The capsules arise from the underside of the thallus and when open bear a tuft of hairlike "elater bearers" on the tip of each of the four valves. The perianths are hispid, with a tiny two-lobed bract at the base. The spores ripen in summer. The plants grow on bases of trees and on rocks in damp cool places, most frequently in elevated regions.

PALLAVICÍNIA.

FIGURE 87. *Pallavicinia Lyellii* (After Sullivant.) Plant; part of thallus with involucre, perianth and calyptra; part of perianth cut away to show young calyptra; capsule closed and open; antheridium enclosed in a leaf; elater and spores.

P. LYELLII S. F. Gray (*Steetzia* of authors) has a flat creeping thallus, ¼ to nearly ½ inch wide, sometimes reaching four inches in length, with margin somewhat sinuate, but not lobed. The thallus is very thin, almost transparent when dry, with a very conspicuous midrib and is simple, or not more than twice branched in the largest plants. The capsules are cylindric with a fringed perianth surrounded by short involucral bracts. The spores are ripe in April. It is widely distributed east of the Rocky Mountains, but is probably more abundant southwards; growing among mosses in swampy places and on moist rocks and soil.

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BLÀSIA.

B. PUSILLA L. is one of the most common of the Thalloid Scale Mosses having a distinct midrib; the midrib is not, however, quite so conspicuous as some of the books indicate. It grows flat on the ground when the plants are few and scattered, but when crowded they become ascending and grow in thick curly tufts like miniature lettuce. The plants are dark green, or even purple, with very distinct almost leaflike lobes along the sides, occupying from ¼-½ the entire width of the thallus. If the plants be held up to the light two dark dots will usually be seen at the base of each lobe. These are peculiar structures known as "leaf-auricles." The spores mature in early spring, but in July and August the young capsules can be seen inclosed in the end of the midrib in the female shoots. When ripe the capsule is elevated on a seta ½-1 inch in height. There is no perianth except the broken tissue of the thallus. A fluffy mass consisting of spores and elaters often remains for some time in the center of the capsule. Flask-shaped bodies like those shown in the illustration are usually abundant on sterile stems; these bear large numbers of gemmae. Pellia often grows mixed with Blasia and as its midrib is frequently as plain as that of Blasia it may be confused with it, but the margins of Pellia are sinuate and less plainly lobed and the roothairs are brown while in Blasia they are white. The dark dots at the base of the lobes distinguish Blasia from Pellia and from all other plants likely to be confused with it. Moist springy roadsides are favorable places for Blasia.

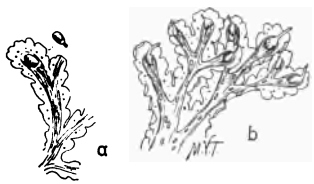

FIGURE 88. *Blasia pusilla.* a. Fertile plant in August natural size, showing capsule in position. At the side is shown the capsule removed from the thallus. b. Sterile plant with flask-shaped bodies which produce gemmæ.

PÉLLIA.

P. EPIPHYLLA (L.) Corda., the Common Pellia, is one of the commonest objects on moist banks. It should be sought for early in May when the slender delicate setæ bearing the open four-valved capsules are striking objects to one who is looking

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for small things. Besides the ordinary elaters, which are so small as to be scarcely recognized, there are a large number of conspicuous "fixed elaters" that remain attached to the center of the open capsule, appearing like a tuft of brownish hairs. The dark or purplish-green thalli frequently cover the ground for several inches. The thallus may reach an inch in legnth by ½ inch in width at apex, but is usually smaller. It is simple or dichotomously branched, with margins sinuate to irregularly lobed and is nearly always notched at the end. In summer if one looks just back of this notch he will see a little flap covering a little hole into the thallus. In August the young capsule will be found in this hole as a little round dark globule, although the spores are not ripe until the next spring. This little flap is the involucre. There is no perianth, but the calyptra is so large when mature that it might be mistaken for one. Along the center of the thallus may be seen little pimples which are the places where the antheridia are produced. These are well illustrated in Fig. 90.

FIGURE 89. *Pellia epiphylla.* Thallus natural size showing involucre and position of capsule as it appears in August.

FIGURE 90. *Pellia epiphylla* (After Hooker) plant; calyptra with lower part of pedicel; an elater; two spores; and two antheridia.

P. ENDIVIAEFOLIA (Dicks.) Dum. and P. NEESIANA (Gottsche) Limpr. are found within our range. Both are dioicous and have none of the pimple-like antheridial dots on the plants bearing involucres. In both, the involucres are tubular as shown in Fig. 91. In *P. Neesiana* the involucres are about $\frac{1}{12}$ inch in height and in *P. endiviaefolia* about twice as long. In fruit *P. endiviaefolia* is distinguished by the fluffy mass of fixed elaters remaining at the bottom of the capsule; they are nearly $\frac{1}{5}$ inch long, two or three times as long as in the other two species.

RICCÁRDIA (Aneura Dumort).

RICCARDIA (ANEURA Dumort) differs from other members of the family in its pinnate or palmate branching. There is almost no apparent costa, the root hairs are comparatively few, and the

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open capsules bear a tuft of "elater-bearers" at the end of the valves as in Metzgeria. For convenience they may be divided into two groups, the first with thallus narrow, about $\frac{1}{24}$ to $\frac{1}{16}$ inch wide, and the second with thallus $\frac{1}{8}$ to $\frac{1}{2}$ an inch wide. There is little danger of confusing the plants of the first group with other plants, except perhaps Metzgeria or *Riccia fluitans*, in which the branching is distinctly dichotomous and the thallus ecostate, and in Riccia the plants are floating-aquatic.

FIGURE 91. Thallus of *P. Neesiana* and portion of thallus viewed from the side, showing the tubular involucre. The middle figure shows the capsule of *P. epiphylla* in position with involucre removed. This is the condition in August. In *P. Neestana* the capsules have not developed at this season.

R. LATIFRONS Lindb. Thallus palmately divided something like the horns of a stag, about an inch long, end branches $\frac{1}{12}$ to $\frac{1}{8}$ inch long, about $\frac{1}{25}$ inch wide. The spores ripen in April and May (Warnstorf). This species nearly always grows on decayed wood and the next on soil. Both favor cool moist situations.

R. MULTIFIDA (L.) Dum. is one to two inches long, bipinnately branched, often much more regularly and evenly so than indicated in the figure; branches rather narrower than in the preceding; spores ripening about the same time. Usually growing on moist banks.

FIGURE 92. *Riccardia multifida*, twice natural size.

There are three other species within our range, but they are scarcely to be distinguished with a hand-lens.

R. PINGUIS (L.) S. F. Gray of the second group is found throughout our range on wet humus. It includes the *R. sessilis* of Gray's Manual.

Howe states that the larger forms when sterile may be mistaken for sterile forms of Pellia and that the "Distinguishing marks are the pinnate instead of dichotomous branching, apices rounded rather than emarginate, texture more rigid when dry

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and a lustre as if saturated with some oleaginous compound." The thallus is 1-2 inches long and $\frac{1}{8}$ to $\frac{1}{4}$ inch in width. It is slightly lobed or sinuate. Spores in spring.

JUNGERMANNIACEAE. The Scale Mosses.

The reproductive part of the Scale Mosses, including the ripened capsule and its connected parts, perianth, involucre, etc., is essentially as in the Thalloid Scale Mosses, but the vegetative part strongly resembles the true mosses in general appearance. The leaves, however, are apparently flattened out into two rows, one on either side of the stem. They are entirely without midrib and are frequently two-cleft or lobed. One of the lobes is often smaller and folded under the other, making the leaves "complicate-bilobed," in the language of the books; this is shown in the illustrations of Radula and Porella. This can best be made out by holding a single stem up to the light and examining with a lens, when the under lobe will show plainly as a deep shadow. In Scapania, the under lobe is the larger and the plants look as if there were four rows of leaves. The lower lobe is often called the lobule and the upper simply the lobe. Very many species have a third row of leaves on the under side of the stem called technically "amphigastria" or under leaves; these vary in size from one-third the size of the ordinary leaves to so minute that high powers of the compound microscope are needed to see them clearly. The upper margin of the leaves may overlap the lower margins of the leaves next above as in Porella, or the upper margin of a leaf may lie under the lower margin of the leaf next above as in Plagiochila. In the former case the leaves are said to be incubous, in the latter succubous. As this distinction is in most cases easy to observe, it is given a prominent part in the key. Occasionally the leaves are so far apart that it is hard to determine the leaf arrangement,

FIGURE 93. *Riccardia pinguis* (After Sullivant). Portions of male and female plants; vertical section of the fleshy calyptra; male receptacle cut transversely and showing antheridia; open capsule, spores, and elater.

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but a careful search will usually discover some plants in which this character can be seen. In plants with incubous leaves the bud is turned downward; when the leaves are succubous the terminal bud is turned up. So far as possible the key has been based upon the leafy or vegetative portions of the plants, but in some few cases the characters connected with the reproductive organs and capsules are necessary to accurately determine a plant. In most cases the characters used can be determined without mounting; if, however, they can not be readily made out the parts should be mounted as for the compound microscope. If one has access to a compound microscope it will often prove a very great help, although not necessary to make out the characters mentioned. Mnium and Fissidens are sure to be mistaken for Hepatics by the beginner unless the midrib or the leaves is noted.

KEY TO THE GENERA.

1. Leaves entirely or in large part composed of hair-like divisions (easily observed if held up towards a strong light) ..... 2.
   Leaves not as above ..... 3.
2. Plants grayish green, growing over the ground amid mosses in cool bogs, at least twice pinnate and somewhat resembling the Fern Mosses; leaves divided to base into hair-like lobes. . . . . *Trichocolea.*
   Plants dark green, much smaller, growing chiefly on rotten wood, but also found on humus-covered stones and soil; leaves with a considerable undivided portion ..... *Ptilidium.*
   Plants exceedingly minute, looking like a small green alga or moss protonema; common on decayed wood, moist soil, etc. . . . . *Blepharostoma.*
3. Leaves incubous ..... A.
   (Scapania, Chiloscyphus, and Cephalozia forms may be sought here.)
   Leaves succubous ..... B.

A

1. Leaves complicate-bilobed, upper lobes entire or nearly so (except Jubula). See figures and description of Porella ..... 2.
   Leaves sometimes lobed or cleft but not complicate-bilobed ..... 5.
2. Plants blackish- or brownish-green, minute, leafy stems $\frac{1}{25}$ inch or less wide, lobule like an inflated sac (Fig. 94.) .... *Frullania.*
   Plants often dark olive-green, but not often blackish; $\frac{1}{18}$ inch in width, lobule not saclike ..... 3.
3. Under leaves lacking; perianth strongly flattened crosswise (Fig 99). . . . . *Radula.*
   Underleaves conspicuous ..... 4.
4. Lobule with its longer edge attached to lower margin of lobe (See Fig. 98); plants small; branches arising below a leaf. . . . . *Lejeunea.*
   Lobule with its shorter margin attached to the lower edge of lobe Fig. 96), plants large; bi- tri-pinnate; branches axillary. . . . . *Porella.*
5. Leaves mostly entire ..... *Kantia.*
   Leaves strongly toothed, notched, or cleft at apex ..... 6.
6. Leafy stems less than $\frac{1}{25}$ inch in width; leaves deeply cleft. *Lepidozia.*
   Leafy stems $\frac{1}{18}$ to $\frac{1}{4}$ inch in width, with downward growing stolons (Fig. 107); leaves toothed ..... *Bazzania.*

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B

1. Leaves complicate-bilobed, lobes nearly equal or the lower larger giving the appearance of four rows of leaves of which the two upper are incubous and the two lower succubous. . . . . *Scapania.*
Leaves not complicate-bilobed, in some cases toothed or divided.... 2.
2. Leaves entire or slightly emarginate.....3.
Some or usually all of the leaves strongly toothed or lobed.....8.
3. Leafy stems about $\frac{1}{2}$ inch wide, leaves oblong, plainly overlapping; on ground and over mosses.....4.
Plants about $\frac{1}{8}$ inch wide, many leaves not overlapping, floating-aquatic.....*Chiloscyphus polyanthos* var. *rivularis.*
Leafy stems $\frac{1}{16}$ inch wide or less; leaves more nearly circular.....6.
4. Plants ascending, growing on stones and very wet soil near brooks. dark green; leaves round-obovate.....*Plagiochila.*
Plants closely applied to substratum of rotten wood, humus, or soil, sometimes creeping over other hepatics and mosses; light-green; sometimes turning dark when dried; leaves oblong to oblong-ovate.....5.
5. Perianth pear-shaped to tubular, abruptly narrowed to the minute opening.....*Jungermannia lanceolata.*
Perianth three-angled, plainly lobed at the top.....*Chiloscyphus.*
6. Leaves plainly margined, apices curved upwards toward each other when dry.....7.
Leaves not margined, apices reflexed when dry .....*Jamesoniella.*
Leaves not margined, apices curved upwards (incurved), when dry .....*Odontoschisma.*
7. Leaves obliquely attached to the stem, bordered by a single row of very large square cells which are easily seen with high power lens.....*Nardia crenulata.*
Leaves attached to the stem almost parallel with its long axis, bordered by several rows of denser cells with thicker walls. . . . . *Odontoschisma.*
8. Upper leaves with a strongly many toothed margin.....*Plagiochila.*
Leaves 3-5 cleft.....*Lophozia barbata.*
Leaves two-toothed or cleft..... 9.
9. Plants minute, leafy stems less than $\frac{1}{25}$ inch wide; underleaves absent or so small as to be invisible with a lens; leaves round-ovate to obovate, cleft for at least ¼ their length..*Cephalozia.*
(Some small species of Lophozia may be sought here, but their leaves are less deeply cleft and the plants are a much darker green).
Leafy stems at least $\frac{1}{25}$ inch wide; leaves two-toothed, but scarcely cleft .....10.
10. Leaves ascending, varying from bidentate to retuse or even entire near apex of stem; leafy stems $\frac{1}{16}$ inch or more wide. . . . . *Lophocolea heterophylla.*
Leaves all two-toothed or cleft.....11.
11. Leaves little longer than broad, concave, ascending.....12.
Leaves much longer than broad, oblong to subrectangular, lying flat on the ground; leafy stems at least $\frac{1}{16}$ inch wide.....13.
12. Leaves subquadrate, inserted crosswise of the stem and subclasping .....*Sphenolobus Michauxii.*
Leaves roundish-ovate, inserted obliquely, not clasping...*Harpanthus.*
13. Underleaves so large as to be made out with a lens; perianth ascending from end of stem or branch.....*Lophocolea.*
Under leaves small and not discernible with a lens; perianth buried in the substratum, attached to the side of the stem.*Geocalyx.*

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*LEAVES COMPLICATE-BILOBED.

FRULLÀNIA.

F. EBORACENSIS Gottsche. Any one who has been in the woods at all must have noticed the pretty designs in dark brownish-green on the bark of beeches and birches like those in the figure. So common and so striking is this little plant that almost no further description is needed for its identification. Although it is so tiny, its underleaves and lobules can be made out easily with a hand-lens if a specimen be mounted in water on a microscopic slide.

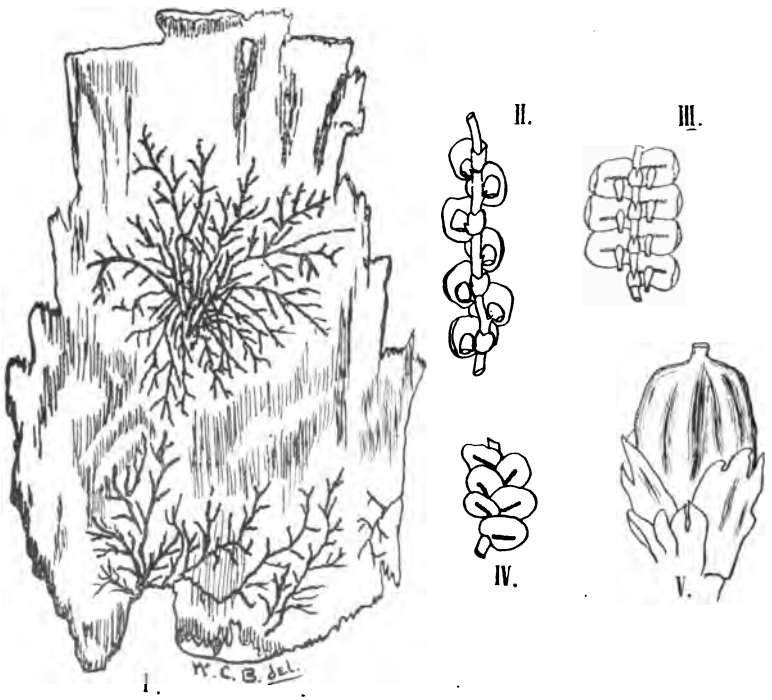

FIGURE 94. *Frullania.* From Bryologist, 5: 4, 1902. I. Plant of *Frullania Eboracensis,* on the bark of birch. II. Underside of same showing underleaves and the queer saclike inflated lobules which remind one of the bladders of Utricularia. III. and IV. Under and upper side of *F. Asagrayana* Mont. V. Involucre and perianth of *F. Eboracensis.*

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F. ASAGRAYANA Mont. is another common species somewhat resembling the preceding, but larger and usually growing on rocks, occasionally on trees. The lobule is much more elongated and there is a line of discolored cells in the middle of the leaf that reminds one of a costa.

The lobule in Frullania is usually modified into a saclike body of various shapes which serves for the temporary retention of water. This saclike form of the lobule is scarcely apparent with a lens, but under the compound microscope becomes a beautiful and interesting object.

There are several other species found within our range, but the compound microscope is needed for their determination.

JUBULA HUTCHINSIAE is a plant likely to be confused with Frullania. It grows on wet rocks, especially in mountains. It is easily differentiated by its strongly lacerate-dentate leaves.

PORELLA.

The Porellas differ from the Frullanias in their larger size, lighter color, larger and entire underleaves, and lobules not saclike, but lingulate to oblong. The lobules are plainly attached by the narrow end to the lobe and extend forward parallel with the stem.

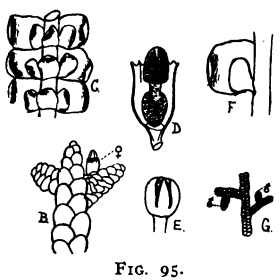

FIG. 95.

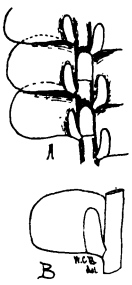

FIG 96.

FIGURE 95. *Porella platyphylla.* From Bryologist, 5: 35, 1902. B. Upper side of stem showing perianth and emerging capsule. Also showing clearly incubous arrangement of leaves. C. Underside of stem, the leaves shown too far apart. D. Longitudinal section of perianth. E. Capsule. F. Leaf. G. Part of plant showing male branches.

FIGURE 96. *Porella pinnata.* From the Bryologist, 5: 34, 1902. A. Underside of stem showing narrow underleaves and narrow lobules attached by their shorter edge to lobe. B. Single leaf showing lobe and lobule.

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The plants are green to brownish-green, rather regularly pinnate and of a comparatively large size as shown by the cuts.

P. PLATYPHYLLA (L.) Lindb., the Common Porella, is found abundantly everywhere and is almost certain to be one of the first half-dozen hepatics to be collected by the beginner. The plants are most commonly collected on the bark of trees, but may be found on logs, rocks, or soil. They are from one to three inches long, 1-3 pinnate with obtuse branches which are closely appressed to the substratum. The perianth is ovoid, narrowed above, denticulate around the mouth. The spores mature in May or June.

P. PINNATA L., the Pinnate Porella, is also common, but much less frequent than the preceding. It is easily distinguished from the Common Porella by the much narrower and more elongated lobule. ~~It grows on rocks and logs subject to inunda-~~ ~~elongated lobule.~~ It grows on rocks and logs subject to inundation.

LEJEUNEA.

The Lejeuneas are tiny plants, our two species being about $\frac{1}{15}$ of an inch wide. They are likely to be mistaken for the Frullanias, but their lobules are not saclike and show plainly that each is the lower part of the leaf turned under, as each is attached to the lobe by its longer edge. The underleaves are unusually large and conspicuous. The Lejeuneas are so much smaller than the Porellas that there is little danger of confusion, but aside from this the difference in lobules noted in the key is very clear and easily made out. The color of the plants is usually lighter than in Frullania or Porella.

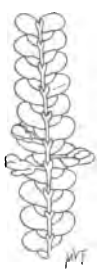

FIGURE 97. *Lejeunea cavifolia.* A portion of a plant from the underside × 6.

L. CAVIFOLIA (Ehrh.) Lindb. is found throughout our range on trees and rocks. The lobules are inflated so that in dry specimens mounted in water a bubble of air nearly always remains inside. The keel formed at the junction of lobe and lobule is strongly curved and the outline of the leaf is indented at the outer end of the lobule. The underleaves are about

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FIGURE 98. *Lejeunea clypeata* (After Sullivant). Plant; portion of stem with two pairs of leaves seen from above; the same from below; portion of a stem with a pair of leaves and a male branch; perianth with capsule and involucral leaves; cross-section of perianth; elaters and spores.

the size of the lobule and rather smaller than in the next. The spores mature in midsummer; perianths may be found in autumn and winter. The perianth is about half exserted, oblong to oval-oblong from a narrower base, rounded at the apex and contracted into a short slender beak resembling that shown in *Jungermannia lanccolata,* sharply five keeled in the upper part. The bifid underleaves which distinguish this species microscopically seem entire with a lens.

L. CLYPEATA (Schwein.) Sulliv. is a rather larger plant found on rocks and trees, from Connecticut southwards. The lobule forms an almost straight keel and the lower (postical) margin of the leaf is much less incurved. The underleaves are much larger than the lobules. The perianth has a rather shorter and broader beak.

RÁDULA.

R. COMPLANATA (L.) Dum. is fully as common as the Common Porella, growing on stones, walls, and roots of trees in dark green mats. The leaves are complicate-bilobed as in all the preceding members of the family, but there are no underleaves and the root hairs are all attached to the lobules instead of to the stem or underleaves as is usually the case. The lobule is attached by the longer margin as in Lejeunea, but the plants are much larger. The spores mature in early spring, but perianths can be found on the plants at almost any season and they are so characteristic as to render recognition easy. They are flattened at the mouth (not well shown in the figures) as if someone had taken them between the thumb and finger and squeezed the upper portion flat. The mature capsules are only slightly exserted from the mouth of the perianth. Besides the spores, the plants often produce gemmæ from the leaves as shown in the figures.

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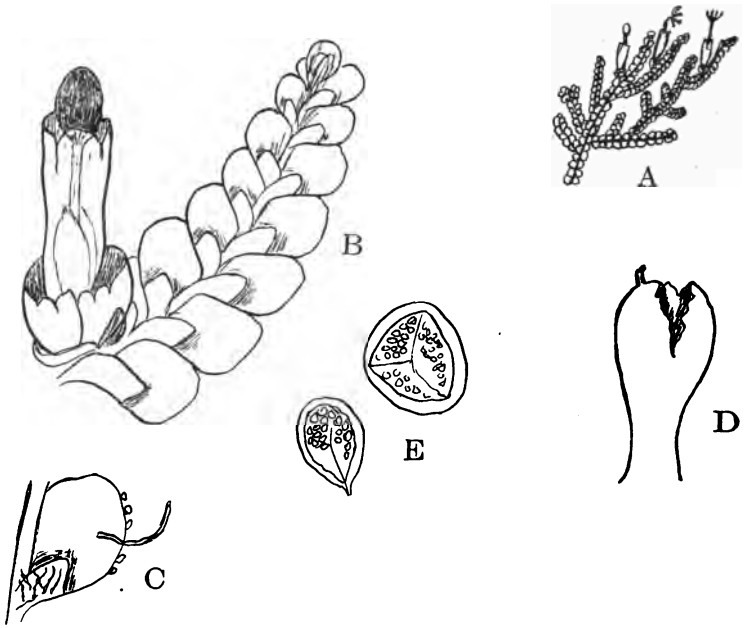

FIGURE 99. *Radula complanata.* A. Plant natural size. B. Branch with fruit showing clearly the seta and capsule, with the calyptra at base of seta showing through the transparent tubular perianth, and at base of the perianth, the involucre. This misrepresents the leaves, making them appear succubous. C. Leaf showing lobule with roothairs and larger lobe with gemmæ along the edge. This illustrates the simplest form of a "complicate-bilobed" leaf. There are no underleaves. D. Calyptra. E. Spores, highly magnified.

SCAPÀNIA.

The Scapanias are large hepatics with the leaves complicate-bilobed, but the upper lobe the larger, so that there appears to be four rows of leaves instead of two. The lower lobes are succubous while the upper sometimes appear incubous. The margins of the leaves are usually dentate or ciliate-dentate. There are no underleaves.

S. NEMOROSA (L.) Dum., the Common Scapania, grows on rocks and moist banks. The lower lobes are dis-

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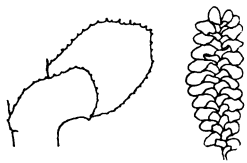

FIGURE 100. *Scapania nemorosa.* Branch × 2. Leaf × 10.

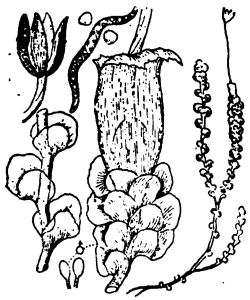

FIGURE 101. *Scapania undulata.* (After Hooker).

tinctly longer than broad and are strongly ciliate-dentate. The leaves are stiff and only a little larger above. The perianth mouth is ciliate-dentate. The spores mature in spring.

S. UNDULATA (L.) Dum., the Aquatic Scapania, is less common than the preceding and grows on stones in streams or in very wet places. It is green, or frequently red or dark brownish-red. The leaves are flaccid and distant below, increasing in size and density above. The upper lobe increases proportionately in size above and in some cases the lobes become subequal; the margins are never so strongly dentate as in the preceding, and the lower are frequently nearly entire. The lower lobes are as broad as long or even broader. The spores mature somewhat earlier than in the preceding. The figure of the entire plant is too small; plants are often found twice as large.

***LEAVES DIVIDED INTO HAIRLIKE DIVISIONS.*

FIGURE 102. *Trichocolea tomentella* a little enlarged and leaf much enlarged.

TRICHOCÓLEA.

T. TOMENTELLA (Ehrh.) Dum., the Woolly Hepatic, derives its name from the fact that the leaves are divided into very numerous hairlike divisions. It is a large plant somewhat resembling the Fern Mosses in its pinnate branching. It is a beautiful gray-green color, twice or more pinnate, and when held up to the light the fine hairlike structure of the leaves is easily apparent. There is no perianth and the involucral leaves coalesce into a hairy tube attached to the calyptra. The spores

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mature in early spring. Frequent in swamps on the ground and over mosses. Although the plants are very distinct from everything else it is very difficult to get a drawing that represents them satisfactorily.

PTILIDIUM.

P. CILIARE (L.) Nees also has its leaves divided into hairlike divisions, but a considerable portion of the base of the leaf is undivided. The plants are small, about $\frac{1}{25}$ of an inch wide, dark green, with leaves spreading when moist, closely imbricated when dry. The perianth is obovate with a fringed mouth. The spores ripen in early spring but the capsules may be found in autumn. The capsule in the illustration was collected in August. Ptilidium is very common on rotten wood and frequently occurs on humus and stones. It fruits very freely and the slender white setæ surmounted by the black capsules are conspicuous objects to one who goes botanizing in early spring.

FIGURE 103. *Ptilidium ciliare*. a. Leaf × 37. b. Plant with perianth and young capsule × 2. c. Portion of plant × 5.

BLEPHAROSTOMA.

B. TRICHOPHYLLUM (L.) Dum. is a third species with leaves divided into hair-like divisions. It is the tiniest of them all and looks more like a beautiful green alga than an hepatic. With the hand-lens the illustration will do more to help recognize it than volumes of description. It is very common on moist earth, stones and decaying wood and usually grows so far apart that the stems appear separate instead of forming mats. The spores mature in early spring, but the perianths are well formed in August.

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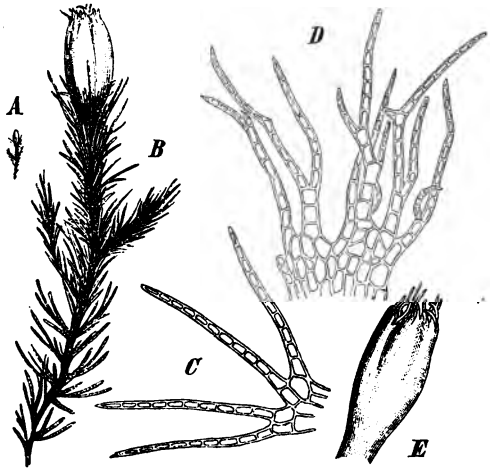

FIGURE 104. *Blepharostoma trichophyllum* (After Schiffner). A. Plant natural size. B. The same × 8. C. Leaf × 50. D. Involucral leaf. E. Perianth × 17.

***LEAVES NOT COMPLICATE-BILOBED OR FINELY DIVIDED,* INCUBOUS.†*

LEPIDOZIA.

FIGURE 105. *Lepidozia reptans* (After Hooker). Plant; portion of stem with leaves and underleaves; antheridium in its leaf, and free; perianth with involucre; capsule, elater, and spores.

L. REPTANS (L.) Dum., the Common Lepidozia, is about the size of Ptilidium, but is much less frequent and is in no danger of being confused with it, for the 3 to 4 cleft leaves curved downwards and looking like a half-closed hand are easily made out with a lens. The Common Lepidozia sometimes grows in tufts or mats, but at first it makes a delicate tracery over the earth or rotten wood on which it grows, unless it be obscured by other plants. The underleaves are cleft much like the others, but are so small as to

*Except Lepidozia species.
†Except Cephalozia.

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be difficult of observation. The perichætial leaves are also cleft like the others, but are much larger and proportionately longer. The perianth is dentate. At first sight this species might be mistaken for a Cephalozia, but a close examination of the leaves will at once show the difference. Dr. Alexander Evans says: "A peculiar habit of the plant is the way in which its prostrate stems creep over tufts of mosses and other hepatics, the tufts thus encroached upon are in time completely covered by the Lepidozia, and, as their supply of light is cut off, they become feeble and finally perish. It is among these crowded patches, and particularly those which grow on rotten logs, that we must look for fruiting specimens, the plants on shaded rocks being almost invariably feebly developed and sterile."

L. SYLVATICA Evans (*L. setacea* of Gray's Manual) is common but might be mistaken for Blepharostoma, but it grows in *dense tufts* and the divisions of the leaves are shorter and are two or three cells wide instead of one as in Blepharostoma.

CEPHALÒZIA.

According to Dr. Evans we have eleven species of Cephalozia in New England. The Cephalozias, however, are so tiny that it is difficult to recognize the species with a lens, although the genus can readily be made out by reason of the small size and peculiar rounded two-lobed leaves which in some species remind one of tiny lobster claws. One or more of these beautiful tiny plants can be collected on every trip if one takes the trouble to look for them. They grow on bare soil, decayed wood, over other mosses and hepatics, almost everywhere that other hepatics will grow.

FIGURE 106. Branch of *Cephalozia bicuspidata* × 2 at the left. At the right *C. multiflora* considerably magnified.

BAZZÀNIA.

B. TRILOBATA (L.) S. F. Gray, the Three-toothed Bazzania, is one of the largest of the scale mosses. It is common on the

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ground in cool moist ravines, swamps, and woods, but reaches its perfect development in the deep mountain woods of New England and similar regions elsewhere. Here it forms deep soft dark-green carpets over earth, stones and debris. The erect ascending stems are 2-5 inches long and $\frac{1}{8}$ inch or more wide with the leaves. The under sides of the stems bear numerous slender flagella with tiny leaves; these the uninitiated are apt to consider as roots. As its name indicates, the oblong-ovate truncate leaves are three-toothed at the apex, but these teeth are not large enough properly to be called lobes. The leaves are plainly incubous as shown in the figures, and somewhat deflexed, i. e., bent toward the ground. The underleaves are easily seen. The spores mature in August and September. The Three-lobed Bazzania is quite variable in size and in unfavorable localities is so small that the beginner may call it the next unless he has seen both and remembers that *B. triangularis* is subalpine.

B. TRIANGULARIS (Schleich.) Lindb. (*B. deflexa* Underw.) is a subalpine species growing on rocks. The leafy stems are about $\frac{1}{16}$ inch wide; the downward growing flagella are present and most of the leaves are 2 to 3 toothed, although some may be entire. The plants vary a great deal in color from dark to light green. I have seen specimens as dark as the Frullanias.

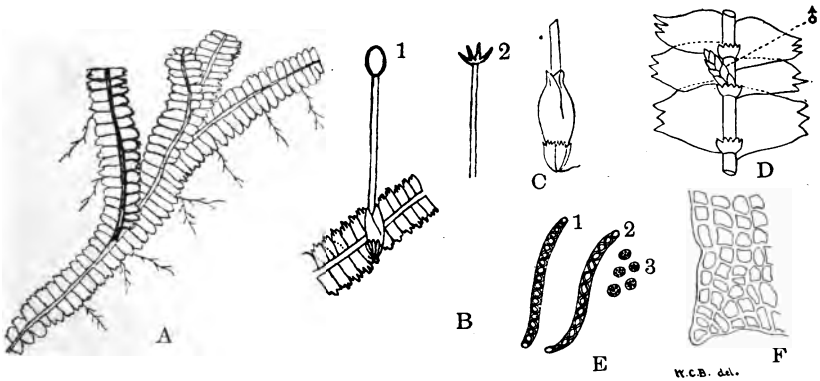

FIGURE 107. *Bazzania trilobata.* From Bryologist, **4**: 68, 1901. A. Plant slightly magnified showing flagella springing from underside. B. (1) Portion of female plant with capsule. (2.) Capsule open. C. Involucre, perianth and base of seta enlarged. The involucre consists of the small leaves at the bottom of the figure. D. Male plant seen from below, showing antheridial branch, minute underleaves and incubous arrangement of leaves. E. & F. illustrate spiral elaters, spores, and cell structure of leaf, which cannot be seen clearly with a hand-lens.

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KÁNTIA.

K. TRICHOMANIS (L.) S. F. Gray, the Common Kantia, is a very common hepatic forming a light green network or mat on moist peaty banks and rotten logs in the woods. It is medium sized, the leafy stems being $\frac{1}{16}$ inch or more wide, often attenuate and ascending with minute leaves at base and ending in a cluster of gemmæ. It may be recognized by the following characters: leaves incubous, not complicate-bilobed, entire, roundish-ovate, lying flat in two opposite rows in one plane, underleaves present but small, bifid at apex; involucre subcylindric, hairy, buried in the substratum and attached to the stem by one side of its mouth; capsule cylindric, the valves spirally twisted. The spores mature in May and June.

FIGURE 108. *Kantia trichomanis.*

All the other species of a similar appearance have leaves lobed or toothed, or succubous.

---

††LEAVES SUCCUBOUS TOOTHED OR LOBED.

PLAGIOCHÌLA.

P. ASPLENOIDES (L.) Dum., the Spleenwort Hepatic, is so called because its stem is so dark as to remind one of some of the darker spleenworts like the Ebony Spleenwort, for instance. The plants are among the largest of the scale mosses, the stems being 1-4 inches long and $\frac{1}{8}$ to $\frac{3}{16}$ of an inch wide with the leaves ascending, not closely attached to substratum, rather loose and straggling. Specimens have been found ten inches long. The leaves are succubous, somewhat irregular in shape, but obovate in general outline, not lobed or cleft, but some or all of the leaves strongly ciliate-dentate. They are very oblique on the stem, subclasping and somewhat decurrent. There are no underleaves, and as the upper portion of the stem is free from rhizoids, this fact is easily made out. The spores mature in May and June,

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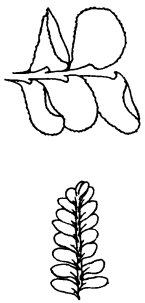

FIGURE 109. *Plagiochila asplenoides.* End of branch slightly magnified and portion of underside of branch × 4.

but perianths can be found in autumn. The "perianth is oblong, narrowed at base, flattened." Common on moist soil and stones in woods, particularly near brooks, strongly resembling some of the creeping stems of some species of Mnium.

There is a form of this species rather common in drier places that has the leaves nearly entire and has passed as a different species under the name of *P. porelloides*. This is now considered but a form of *P. asplenoides*, which varies greatly and will be collected for something else several times before the student gets to know it thoroughly.

GEÓCALYX.

G. GRAVEOLENS (Schrad.) Nees. is our only species. It gets its specific name from the fact that it has an underground involucre much like that of Kantia, which it somewhat resembles in habit and gross appearance, but its leaves are subrectangular and very deeply two-toothed at the ends as shown in the figure. The underleaves are present, but so small as to be made out with difficulty with a lens. The spores are ripe in May, but the perianths are present in summer.

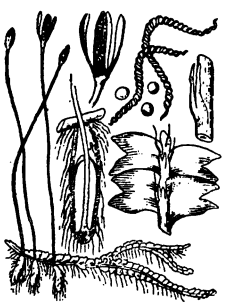

FIGURE 110. *Geocalyx graveolens*: plant natural size; two pairs of leaves with under leaves; part of stem with an underleaf; section of involucre showing calyptra and base of pedicel; dehiscent capsule, elaters and spores. (After Sullivant.)

LOPHOCÓLEA.

The Lophocoleas are very similar in habit and size to Geocalyx, but their underleaves are larger and the perianths are borne on the end of a stem or primary branch. The leafy stems in the species treated are about $\frac{1}{16}$ of an inch wide in both genera.

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L. HETEROPHYLLA (Schrad.) Dum., the Variable Lophocolea, is a very common plant, bright green in shaded places, yellowish-green when exposed to the sunlight. Like Kantia and Geocalyx it is found on rotten logs and on soil, but its ovate to oblong-ovate leaves are not all alike; many of the leaves, especially on young and tender stems, are as deeply two-toothed as in Geocalyx, but with a more rounded notch. On other parts of the same stem some of the leaves are only slightly notched or are entire. This variation of the leaf shapes is so constant as to afford a good means of recognizing the species. The leaves are usually somewhat ascending. The under leaves are deeply cleft, but are too small to study readily with the lens. The perianth is deeply three-lobed and each lobe again lobed and toothed. The capsules are a little longer than broad and mature in May. It is more frequent in the lowlands than at higher altitudes.

FIGURE 111. *Lophocolea heterophylla*: plant natural size; portion of stem with leaves and perianth; two portions of stem with leaves and underleaves, one showing an antheridium, etc. (After Sullivant.)

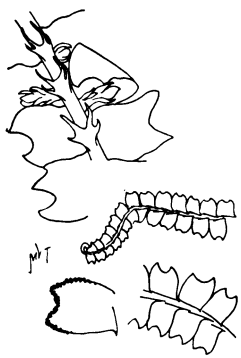

FIGURE 112. *Lophocolea minor*. Portion of stem × 2; another portion × 4; a portion viewed from the underside × 16, and a leaf bearing gemmæ.

L. MINOR Nees. is more frequent. southwards. It is almost sure to be mistaken for Geocalyx when sterile. The underleaves are larger, $\frac{2}{3}$ as long as the leaves are wide, and the edges of the leaves frequently bear minute gemmæ which make the margin look darker and less distinct. The perianths are situated on the ends of the stems and branches. Another species, *L. Austinii* Lindb. occurs with this, but cannot be distinguished with a lens. Bases of trees in woods and moist limestone rocks are said to be good places to collect these two species. The perianths are present in November and the spores probably mature in spring.

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HARPANTHUS SCUTATUS (Web. & Mhor.) Spruce is a third not infrequent species likely to be confused with the preceding, but the plants are so much smaller (scarcely $\frac{1}{15}$ of an inch in width), that one who has seen all four will have no difficulty. The leaves are short-ovate, more ascending. The spores mature in May and June. The favorite habitat is old logs in damp places.

SPHENOLOBUS MICHAUXII (Web.) Steph. is about the size of the preceding, but is a plant of mountainous regions with a much darker color; the leaves are inserted nearly crosswise of the stem and are almost sheathing at base; when dry they are more or less folded together. The perianth is cylindrical. On rotten wood.

This plant was formerly put in the genus Jungermannia and there are several plants of that genus as treated in Gray's Manual that may be sought here. They are, however, for the most part plants of smaller size and less frequent occurrence. Many of them are confined to mountainous regions and many can not be well determined with a lens.

LOPHOZIA (Jungermannia in part).

This genus which has usually been treated as a subgenus of Jungermannia consists of numerous species of creeping forms with succubous leaves which are not much longer than broad and are markedly toothed or cleft at the apex. Many are alpine or subalpine.

L. BARBATA (Schreb.) Dum. is common in the mountains of New England and New York on damp shaded rocks, sometimes on rotten logs or banks. It is rare or entirely lacking in the southern portion of our range. The leafy stems are an inch or more long and about $\frac{1}{12}$ inch wide. It usually grows in flat tufts closely applied to the substratum, but occasionally the stems are ascending or erect. The shade of green of the plants depends upon the amount of light they receive; in full sunlight they have a yellowish-brown tinge. The leaves are more or less quadrate in outline and are divided at the apex into three or four teeth or lobes; there are no other teeth or marginal markings. The plants are dioicous and the antheridial plants are slightly different from the spore-producing or female plants as is shown in the figures.

L. INCISA (Schrad.) Dum. In this plant the leaves are 2-6 lobed, but two of the lobes are larger and the leaf has a

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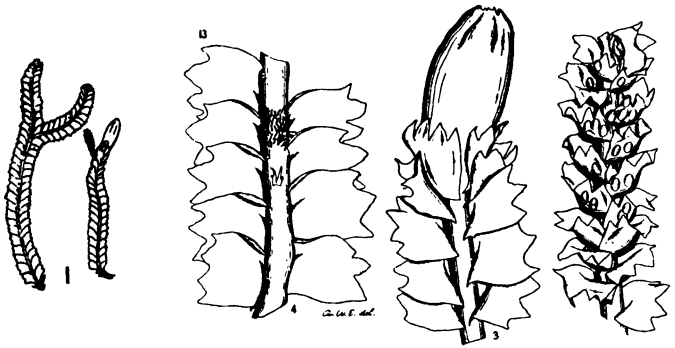

FIGURE 113. *Lophozia barbata* (After Evans). 1. Plants natural size. 3. Female plant from above. 4. Underside of a portion of sterile stem. The figure at the right is an antheridial stem from above.

tendency to assume the folded form as in Scapania so that many consider the leaves two-lobed with the lobes toothed. The plants are smaller than in *barbata* and usually grow on decaying wood.

Our other species of this genus (except some very rare or alpine forms) have two-lobed or two-toothed leaves and are more likely to be confused with Sphenolobus.

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†††*LEAVES SUCCUBOUS, ENTIRE, SCARCELY LONGER THAN BROAD.*

ODONTOSCHÍSMA.

Leafy stems $\frac{1}{16}$ inch or less wide, creeping and interwoven, green, to red-brown with a trace of green; branches usually rising from the underside of stem; leaves entire, rarely emarginate or bilobed, often bordered. Underleaves invisible with a lens. The perianth is on a short lateral branch which distinguishes all the species from Jamsoniella.

O. PROSTRATUM (Swartz) Travis (*O. Sphagni* of American authors). The plants of this delicate and pretty hepatic grow mostly in swamps over and among mosses and other bog plants, rarely on rotten wood. The stems are creeping with ascending tips; leaves distant to closely imbricate, not growing minute at base and apex of branches, attached very obliquely, not flattened out but ascending and forming a channel between the two

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rows, outer ends (apices) folding inwards towards each other when dry, nearly circular to oblong, plainly margined and margin clearly to be seen with high power lens. Gemmæ lacking. This species is found in Massachusetts and southwards.

O. DENUDATUM (Mart.) Dum. grows principally on rotten wood or peaty banks throughout eastern North America. The leaves are not margined and diminish in size towards both ends of the stem or branch; they are more concave than in the preceding, but take the same position when dry. Gemmiparous branches with much diminished leaves are frequent.

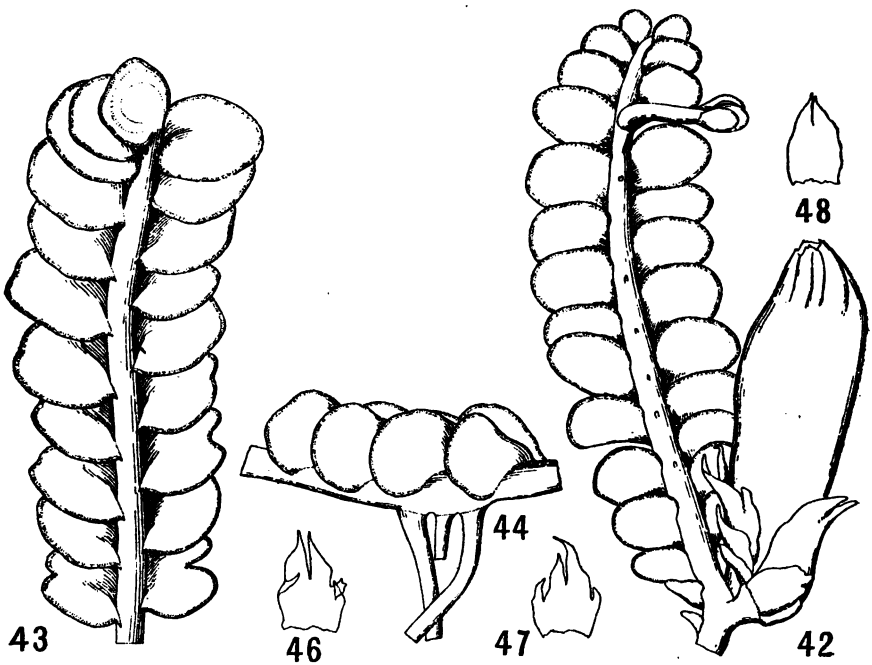

FIGURE 114. (After Evans). Upper, under, and side view of stem of *Odontoschisma prostratum* and perichaetial bracts all × 18.

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JAMSONIELLA.

JAMSONIELLA AUTUMNALIS (DC.) Steph. (*Jungermannia Schraderi* Mart.) is a common species often confused with *Odontoschisma prostratum*. It appears to be a plant of more elevated and cooler regions than Odontoschisma, as I find it abundantly in the hills of southern Vermont, but not a trace of it near New York City. It most frequently grows on decaying wood, but may be found on soil, trunks of trees, etc. It is sometimes plain green, but usually dark green to brownish in the older portions. The leaves are nearly circular to short-oblong, not margined, with the ends reflexed when dry as shown in the figures. Flagella and gemmæ wanting. The perianth is terminal on a leading branch, which distinguishes it from all forms of Odontoschisma when fertile. The position of the leaves when dry easily distinguishes sterile specimens.

FIGURE 115. One moist and two dry branches of *Jamsoniella autumnalis* × 5.

NARDIA.

There are several species of this genus within our range, but they are hardly to be made out with a lens except perhaps N. CRENULATA (Smith) Lindb. It is a smaller plant than the other round-leaved hepatics and grows on soil throughout our range. Mounted and examined with a high power lens it will at once be recognized by the margin, made up of a single row of very large square cells as shown in the figures. The margin is more distinct than in Odontoschisma and after mounting shows much more clearly. In that genus the margin is made up of two or three rows of much less strongly differentiated cells.

FIGURE 116. Side and top view of a stem of *Nardia crenulata* by about 20, and portion of leaf × 100.

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††††LEAVES SUCCUBOUS, ENTIRE, MARKEDLY LONGER THAN BROAD.

JUNGERMÁNNIA.

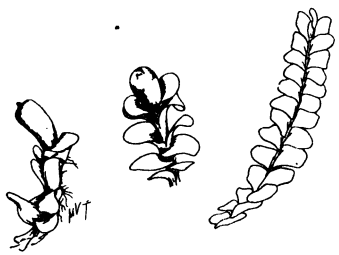

FIGURE 117. *Jungermannia lanceolata;* portion of sterile stem × 2½; and two perianths × 4.

J. LANCEOLATA L. (*Liochlaena lanceolata* of many authors) is a common species on rotten logs and banks. The leaves are recurved at apex when dry as in *Jamsoniella,* but the plants are fully twice as wide and the leaves are much longer than broad. Sterile it may be confused with other forms, but with the pretty puckered perianths present, looking like a full bag tied with a string, there can be no danger of confusing it with anything. The perianths are present and well developed in August; the spores mature in spring.

CHILOSCÝPHUS.

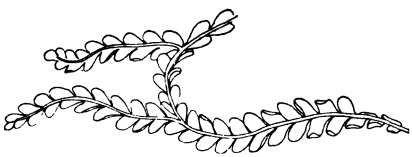

FIGURE 118. Portion of a stem of *Chiloscyphus polyanthos rivularis* natural size.

C. POLYANTHOS (L.) Corda is our only common species. It is very large, the stems sometimes reaching a foot in length and, with the leaves, being about $\frac{5}{16}$ of an inch wide. This species grows on rocks and soil in wet places and occasionally in slowly flowing water. The color is a deep green, sometimes becoming blackish; when of this color it somewhat resembles *Plagiochila asplenoides,* but the leaves are very entire and at the end of the shoots the underleaves can usually be made out clearly, as the plant tissues are quite transparent. The underleaves are rather small and are deeply bifid with very narrow slender segments. Spores in April and May. Var., *rivularis* a floating form with leaves scarcely overlapping, often more distant than those shown in the figure.

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ILLUSTRATED GLOSSARY OF BRYOLOGICAL TERMS.*

THIS is not intended to be an exhaustive glossary of botanical terms, but mainly a glossary of those terms which are either confined to bryological works or are used in a somewhat different meaning when applied to mosses. Thus the common terms descriptive of leaves are omitted, except acumen and a few others that are used in a peculiar or unusual way by some authors. Very few terms are here defined that are sufficiently well explained in the common phanerogamic botanies like Gray, Wood, or Britton and Brown.

Braithwaite's "British Moss Flora," Lesquereux and James' "Manual," and Dixon and Jameson's "Handbook of British Mosses" have been largely consulted, and an attempt has been made to determine the meaning of each term according to the usage of all the authors accessible.

For most of the cuts we are indebted to the kindness of Mr. H. N. Dixon, Mr. Jameson, and their publishers, who have very kindly allowed us the use of the cuts in their "Handbook of British Mosses," a work which should be in the hands of every moss student whether English or American. Figs. 43 and 46 are from Mrs. Britton's "Observer" article, by consent. Terms whose meaning can be made sufficiently clear by definition are not illustrated as a rule.

FIG. 1.

Acicular, needle-shaped. Applied to the beak of the operculum.

Acrocarpous, having the sporophyte terminal on a stem or ordinary branch. Acrocarpous mosses can usually be easily distinguished by the erect habit, as shown in the figure. (Fig. 1.) The old sporophyte often seems lateral in acrocarpous mosses, because the stem grows on the next year from a point just below the base of the sporophyte.

*The figures of the Glossary are numbered independently of the rest of the book.

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Acumen, the gradually tapering narrow point of an acuminate leaf. (Fig. 2, *b.*)

Acuminate, a term usually applied to leaves that gradually taper to a narrow point. A few recent writers use the term as applying only to those leaves that are not uniformly narrow and limit the term acumen to that part of the apex beyond the point where the narrowing begins to be less abrupt. According to those authors a leaf uniformly narrowed would not be acuminate, no matter how slender the apex. The author has followed this usage to some extent in previous writings, but general usage does not seem to sanction this restriction of the term.

FIG. 2.

Acumination. See *acumen* and *acuminate.*

Acute, with a sharp point, shorter than acuminate.

Aggregate, clustered; usually applied to two or more sporophytes from one perichætium.

Alar cells, the cells at basal angles of the leaf, commonly different from cells of the main part of the leaf, being shorter and often nearly square, or inflated and hyaline, and often highly colored. (Fig. 3.)

FIG. 3.

Amphigastria, the third row of leaves found on the under side of the stems of the *Hepaticae.*

Angular cells. See *Alar cells.*

Antical, applied to that surface of the stems of hepatics which is uppermost when the stems are prostrate.

Antheridium, the male reproductive organ containing the antherozoids. (Fig. 4.)

Antherozoid, the small flagellate male cell which escapes from the antheridium, and in wet weather swims to the archegonium and down its neck to the egg-cell in the bottom.

FIG. 4.

Apical cells, the cells composing the apex of the leaf. They are often broader and shorter than the cells of the middle of the leaf.

Apophysis. See *hypophysis,* the more correct term according to Braithwaite.

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FIG. 5.

Archegonium, the flask-shaped female reproductive organ. (Fig. 5.) See, also, *antherozoid.*

Arcuate (capsule), bent in a curve like a bow. (Fig. 6.)

Areolation, the net work formed by the outlines of the cells of a leaf.

Astomous (capsule), without a mouth. Used of capsules which have no regularly dehiscent lid.

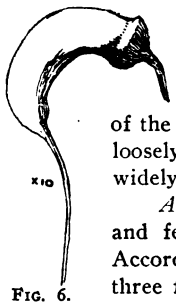

FIG. 6.

Auricles, small lobes at the basal angles of the leaf, usually consisting of cells differing from those of the main part of the leaf in size or shape or both. (Fig. 3 and Fig. 2, *a.*) Properly used only when there is an outward curve in the outline of the leaf at the base, as in the figures, but often used loosely to denote the basal angles of widely decurrent leaves.

Autoicous or *autoecious,* having male and female organs on the same plant. According to Braithwaite, there are three forms.

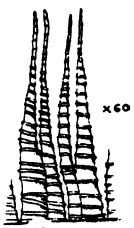

FIG. 7.

1. *Cladautoicous,* with the male organs on a special proper branch.

2. *Gonioautoicous,* with the male organs in a bud-like cluster, and axillary on a female branch.

3. *Rhizautoicous,* male branch very short and cohering to the female by the rhizoids.

Axil, the angle at the base of a leaf between it and the stem.

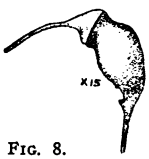

FIG. 8.

Basal or *basilar* cells, cells at the base or insertion of the leaf, often of different shape and color from those of the main part of the leaf.

Beak, prolonged narrow tip of the operculum. The opercula in Figs. 6 and 8 are strongly beaked.

Bicostate, having a double costa, which is usually much shorter than in leaves having a single costa.

Bifarious, growing in two ranks.

Bifid, cleft into two divisions like the amphigastria of Chiloscyphus or the teeth of Dicranum.

Bi-sexual, synoicous.

Bordered, having a margin different from the rest of the leaf. In Mnium and Bryum (which see), the border consists of a few rows of greatly elongated cells, often in two or more layers.

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In some species of Fissidens the border is of a different color, but with little difference in cell structure.

Bracts, a term applied to the leaves surrounding the reproductive organs. Those surrounding the antheridia are called perigonial bracts or leaves, and those surrounding the archegonia and base of seta are called perichætial.

Brood bodies. See propagula.

Bulbil, a minute bulb or bulb-shaped body, usually produced for asexual reproduction.

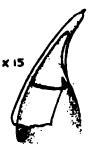

FIG. 9.

Caespitose, forming matted tufts or cushions; e. g., *Leucobryum.*

Calyptra, the thin veil or hood covering the mouth of the capsule. (Figs. 9 and 22.)

In the Hepatics the capsule breaks through the top of the calyptra, leaving it at the base of the seta instead of on top of the capsule. (See Marchantia.)

Campanulate, bell-shaped.

Canaliculate, channeled. Applied to leaves with margins incurved, so as to give them a channel-like form; e. g., the upper part of the leaves of *Dicranum fuscescens.* A more complete inrolling until the margins meet would make the leaf tubulose.

Canescent, rather hoary.

Capitulum, a rounded head.

Capsule, the enlarged distal end of the sporophyte; it contains the spores, and is sometimes known as the sporangium. (Figs. 6, 8, 10 and 17.)

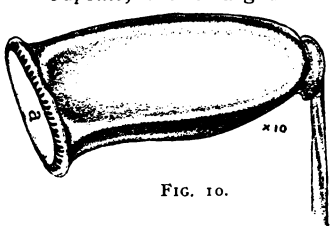

FIG. 10.

Carinate, keeled like a boat; e. g., segments of inner peristome in Fig. 27.

Cernuous (capsule), drooping or nodding, somewhat inclined as opposed to erect. (Fig. 10.)

Chlorophyll, the green coloring matter in plants.

Cilia, hair-like threads of the endostome, alternating with the segments. (Fig. 11 *c,* and 27 *d.*)

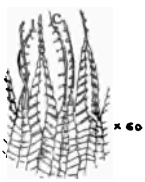

FIG. 11.

Circinate, curved into a circle, resembling Fig. 2, but still more incurved, so that the apex is nearly or quite bent around to the leaf base; e. g., leaves of *Hypnum uncinatum.*

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Cirrate or *cirrhate,* applied to leaves which curl up in drying. Cirrate leaves are more regularly curled than crispate leaves.

Cirrhose, having a wavy hair point.

Cladocarpous, having the sporophyte terminating a short special fertile branch; somewhat like half-way between acrocarpous and pleurocarpous; e. g., *Fontinalis.*

Cleistocarpous, capsule opening irregularly, not by a lid or valves.

Cochleariform, rounded and concave like a spoon or ladle.

Collum, the neck or tapering base of the capsule. (See Fig. 21.)

FIG. 12.

Columella, the central axis of the capsule; around it and between it and the outer wall of the capsule are borne the spores. Sometimes the lid adheres to it and is raised upon it, as in Fig. 12.

Coma, Comal tuft, a tuft of leaves at the tip of a stem or branch.

Complanate (of leaves or branches), flattened out more or less in one plane.

Complicate, folded together.

Complicate-bilobed, two lobed with one lobe folded under and against the other as in Radula. No mosses have leaves with this structure.

Confervoid, formed of fine threads.

FIG. 13.

Constricted, used of capsules that become narrowed under the mouth when dry. (Fig. 8.)

Contracted. See *constricted.*

Cordate, heart-shaped.

Costa, the nerve or midrib of a moss leaf.

Costate, having a costa.

Crispate or *crisped,* frizzled, curled and twisted in various ways. (Fig. 13.)

Cucullate, hood-shaped, the apex curved in like a slipper. (Apex of leaf in Fig. 14.)

Cucullate calyptra, a calyptra that is hood-shaped and split on one side only. (Fig. 9.)

Cultriform, curved like a short, wide scimitar; e. g., the leaves of *Homalia trichomanoides Jamesii.*

Cygneous (seta), curved suddenly downward, like a swan's neck.

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FIG. 14.

Cymbiform, boat-shaped (used by Dixon as a synonym of cucullate); e. g., leaves of *Sphagnum cymbifolium.* (The whole leaf in Fig. 14.)

Deoperculate, applied to a capsule after its lid has fallen off.

Dichotomous, branching by forking repeatedly into two branches.

Dimidiate, split on one side.

Dioicous or *dioecious,* having the male and female organs on separate plants.

Distichous (of leaves), in two opposite rows on the stem.

Dorsal, belonging to or on the back; i. e., the face of a leaf remote from the stem.

Ecostate, lacking a costa.

Emarginate, having a small notch at the end of apex as in the figure of the leaves of *Lophocolea heterophylla.*

Emergent or *emersed,* half uncovered; of the capsule, when the perichætial leaves reach but do not overtop it.

Endostome. See under *peristome.*

Epiphragm, a membrane covering the mouth of the deoperculate capsule; in Polytrichum and its allies it consists of the dilated top of the columella. (Fig. 10, a.)

FIG. 15.

Erecto-patent, midway between erect and patent.

Excurrent costa, a costa running out beyond the lamina of a leaf. (Fig. 15.)

Exostome. See under *peristome.*

Exserted, elevated above the surrounding parts; of the capsule, when the perichætial leaves do not reach so high as its base.

Falcate, curved like a sickle. (Fig. 2.)

Fascicle, a bunch or cluster of leaves or branches.

Fasciculate, arranged in bunches.

Fastigiate, of branches, all reaching an equal height. (Fig. 1.)

Flagella, fine string-like branches; e. g., *Dicranum flagellare.*

Flexuose, bent backward and forward, or wavy.

Flowers, often applied to the reproductive organs.

Fruit, often applied to the sporophyte.

Fuscous, dull brown.

Gametophyte or *gametophore,* that part of the plant which bears the gametes or sexual cells. In mosses and hepatics, all the plant except the "fruit," or seta and capsule.

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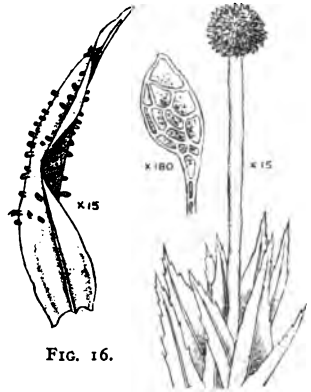

FIG. 16.

Gemmae, bud-like bodies, capable of reproducing the plant. Sometimes borne in special heads, sometimes on the surface of the leaves. (Fig. 16.)

Gemmiferous or *gemmiparous,* bearing gemmæ.

Gibbous (capsule), more tumid or swollen on one side than on the other. (Fig. 17.)

Glaucous, originally applied to plants covered with a bluish white bloom, but also applied to mosses that have that color.

Gregarious, growing near together or clustered, but not in close tufts or mats.

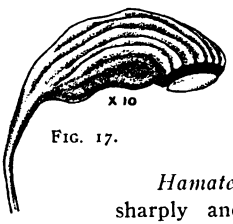

FIG. 17.

Gymnostomous, without a peristome.

Habitat, the place in which a plant grows; often used in a general way to designate the kind of place usually occupied by a plant.

Hamate or *hamulose,* curved like a hook; more sharply and abruptly curved than in *falcate* and *circinate.*

Heteromallous (leaves or branches), turned in different directions.

FIG. 18.

Homomallous, turned in the same direction.

Hygroscopic, readily absorbing water and thereby altered in form or direction. *Hygrometric* is sometimes used with a similar meaning.

Hypophysis, a swelling of the seta immediately under the capsule. (Fig. 10.)

Imbricated, closely overlapping each other like the tiles of a roof. (Fig. 18.)

Immersed, covered up; of the capsule when the perichætial leaves project beyond it.

Incubous, of the leaves of Hepatics, having the upper margin overlapping the lower margin of the leaf next above. (See Porella and Radula.)

Incrassate, thickened; becoming thicker by degrees

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Inflated, applied to the alar cells of leaves when enlarged much beyond the size of the neighboring cells. (Fig. 19.)

Involucre, the circle of single or united bracts surrounding the perianth in the Hepatics. (See Marchantia.)

FIG. 19.

Inflorescence, often applied to the clusters of reproductive organs.

Julaceous, smooth, slender and cylindric; like a catkin or a worm.

Lamellae, thin sheets or plates of tissue; e. g., the plates arising from the costa of the hair-caps and their allies. (Fig. 20.)

Lamellate, having lamellæ.

Lamina, the blade or expanded part of the leaf as distinct from the costa.

Lanceolate, long and narrow, but widest at base like the head of a lance. (Fig. 30.)

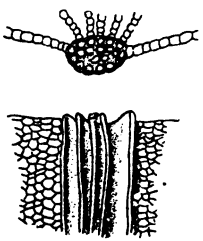

FIG 20.

Leptodermous, thin-coated; applied to capsules when soft and pliable.

Lid. See *operculum.*

Limb, the upper part of a leaf as distinct from the leaf base.

Linear, long and very narrow and of the same width at both ends, like a line.

Lingulate, tongue-shaped; e. g., the leaves of *Rhacomitrium aciculare.*

Lobe, the upper and usually larger lobe of the complicate-bilobed leaves of Hepatics.

Lobule, the under and usually smaller lobe of the complicate-bilobed leaves of Hepatics. (See Radula.)

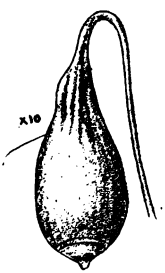

FIG. 21.

Mamillate or *mammillar* (lid of the capsule), convex with a short projection in the center. (Fig. 21.)

Margined. See *bordered.*

Mitriform (calyptra), cleft on two or more sides, and symmetrical. (See figure of Bruchia p. 36.)

Monoicous or *monoecious,* having male and female organs on the same plant.

Muticous, not pointed.

Neck (of the capsule), the lowest part just above the point where it joins the seta. See, also, *collum.*

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Nerve. See *costa.*

Oblong, broad, of the same width at both ends and longer than broad.

Ochrea, a thin sheath around the base of the seta, terminating the vaginula.

Oösphere, the egg-cell or ovum found in the base of the archegonium. (Fig. 5.) After fertilization, by union with the antherozoid, it develops into the sporophyte.

Operculum, the lid which closes the capsule and, falling, permits the spores to escape. (Figs. 8, 12, and 21.)

FIG. 23.

Ovate, shaped like lengthwise section of an egg, always broadest a little above the base.

Pachydermous, thick-skinned; applied to the walls of capsules or to cells when firm and resisting.

Papillae, minute rounded or acute protuberances.

Papillose, rough with papillæ. (Seta), rough with small rounded or acute protuberances. (Fig 23.)

FIG. 24.

Paraphyllia, minute leaf-like or much-branched organs among the leaves. (Fig. 24. E. g., *Thuidium.*

Paroicous, having its male and female organs in the same cluster, but not mixed, the antheridia being in the axils of the perichætial bracts below the archegonia. (Fig. 26.)

FIG. 25.

FIG. 26.

Patent, spreading at an angle of 26°-45° (Braithwaite); spreading at an angle of 45° or more (Dixon).

Patulous, more widely spreading than *patent.*

Pedicel. See *seta.*

Pendulous, somewhat hanging or drooping; more so than in *cernuous.* (Fig. 21.)

Percurrent costa, reaching to the apex of the leaf, but not beyond.

Perianth, the inner, usually saclike structure surrounding the base of the seta in Hepatics. (See Marchantia.)

Perichaetial. See *bracts.*

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Perigonial. See *bracts.*

Peristome, the fringe surrounding the mouth of the capsule upon removing the lid. This fringe may consist of a single row of processes, known as *teeth,* as in Fig. 7, or of a double row as in Fig. 27. In the latter case the entire fringe is still the *peristome,* but the term is also applied in a particular sense to the outer row; the outer row is often spoken of as the *exostome* (*b*), and the inner as the *endostome* (*c*). The inner row consists of as many projections as the outer, but alternating with them; these are known as *processes* or *segments* (*c*). Between the segments there are often one or more slender hair-like processes known as *cilia.* (Fig. 27, *d;* Fig. 11, *c.*)

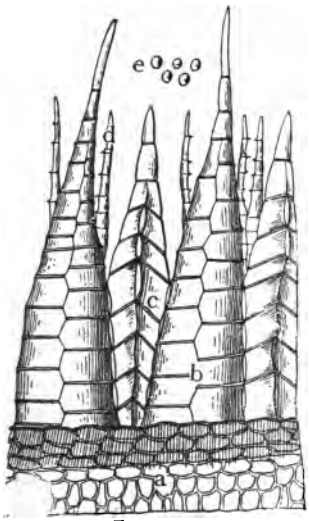

FIG. 27.

Moss peristomes, viewed with a compound microscope, are among the most beautiful of natural objects. They are not composed of cells (except in the Polytrichaceæ and a few other small families), but of thickened cell-walls.

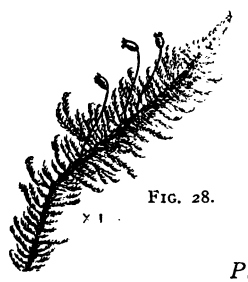
FIG. 28.

Pinnate, having numerous equidistant spreading branches on each side like a feather. (Fig. 28.)

Pleurocarpous, having the sporophyte lateral on a short lateral special branch. (Fig. 29.) Pleurocarpous mosses can usually be recognized by the creeping habit.

Plicate, folded in pleats or furrows; e. g., leaves of Camptothecium. (Fig. 30.)

Plicae, folds of a plicate leaf.

Plumose, feathery.

Pluriseriate, many ranked; i. e., as applied to leaves arranged in several rows along the stem.

Polygamous, with antheridia and archegonia disposed in

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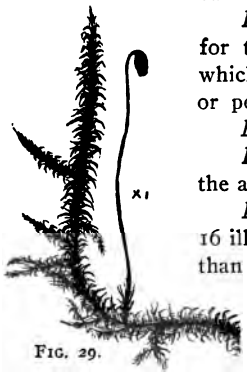

FIG. 29.

various ways on the same plant.

Postical, used as the opposite of antical for that surface of the stems of hepatics to which the underleaves are attached, the under or posterior surface.

Processes. See under *peristome.*

Proliferous, bearing young shoots from the antheridial or archegonial cluster of leaves.

Propagula. According to Dr. Best, Fig. 16 illustrates *brood bodies* or *propagula* rather than gemmæ.

These distinctions are not made in all works.

Protonema, the green, branched, alga-like threads produced from the spore and often persistent during the lifetime of the plant produced from it. Protonema and radicles differ chiefly in the presence or absence of chlorophyll, and either may develop the other. (Fig. 31.)

FIG. 30.

Pseudopodium, a leafless branch resembling a seta and often bearing gemmæ. (Fig. 16.) Of sphagnum, the stalk (false seta) bearing the capsule.

Pulvinate, like a cushion.

Pyriform, pear-shaped.

Radicles, rootlets springing from the sides and base of the stem. See also *protonema.*

Ramuli, minute branchlets.

Rhizoid. See *radicles.*

Rostellate (operculum), with a short beak.

Rostrate (operculum), with a long beak. (Figs. 6 and 8.)

FIG. 31.

Rosulate, in the form of a rosette.

Rough. Same as *papillose.*

Rugose, wrinkled, in the case of leaves it is usually applied to transverse wrinkles; e. g., leaves of *Hypnum rugosum.*

Scabrous. Same as papillose.

Secund, twisted or turned to one side. (Fig. 32); e. g., leaves of many *Hypnums.*

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FIG. 32.

Sessile, without any stalk, like the leaves of all the mosses or the capsules of Webera.

Segments. See under *peristome.*

Seta, the stalk on which the capsule is borne. (Figs. 6 and 10.)

Sigmoid, curved like the letter S.

Spermatozoid. See *antherozoid.*

Sporangium, often applied to the capsule, but by some authors restricted to the spore sac, or inner sac of the capsule containing the spores.

Spores, small round bodies contained in the capsule, serving the purpose of seeds, but in no way homologous with them. (Fig. 27.)

Sporophyte or *sporophore,* the spore-bearing part or generation. In mosses it consists of the seta and capsule and constitutes the so-called fruit.

Sporogonium, the sporophyte or spore-bearing part of the moss.

Squarrose, spreading at right angles from the stem.

Stegocarpous, having the capsule operculate.

Stipitate, having a short stem. Applied to antheridia and archegonia.

Stoloniferous stem, a slender creeping stem with minute leaves.

Stomata, pores in the surface of the thallus of the True Liverworts.

Striate, marked with striæ or slight furrows.

Struma, a goiter-like swelling on one side at the base of the capsule. (Fig. 8.)

Strumose, having a struma.

Substratum, the material upon which the plant grows.

Succubous, with the upper margin of one leaf lying under the leaf next above. (See Plagiochila.)

Sulcate, deeply furrowed with longitudinal channels. As applied to leaves, both *striate* and *sulcate* really refer to the fold whose concave surface is on the inner or ventral surface of the leaf. Of the capsule, deeply furrowed. (Fig. 17.)

Synoicous or *synoecious,* having the male and the female organs mixed together in the same cluster. (Fig. 25.)

Terete, circular in cross-section.

Thallus, a broad, flattened plant form taking the place of

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both stem and leaves on many of the lower plants. (See Marchantia.)

Tomentose, covered with a thick felt of radicles.

Tooth. See under *peristome.*

Tubulose. See *canaliculate.*

Tumid, turgid, appearing as if swollen from pressure within.

Turbinate, top-shaped; e. g., capsule of *Bryum turbinatum.*

Twisted (seta). The seta of many mosses twists strongly in drying. If the twist is such as would be made by seizing the capsule and twisting it to the right, it is said to be twisted to the right. It is possible that this twisting of the seta aids in scattering the spores.

FIG. 33.

Umbonate, round with a projecting point in the center.

Uncinate, hooked, curved back at point. (Fig. 32.)

Undulate, with an alternately concave and convex margin, wavy; e. g., leaves of *Dicranum undulatum.*

Urceolate, shaped like an urn or pitcher.

Veil, the calyptra.

Ventral surface, the surface of a leaf next the stem.

Ventricose, bulging on one side. (Fig. 33.)

Vesicular, inflated like a bladder.

Wavy. See *undulate.*

ERRATA.

P. 39. Accent Oncophorus as on p. 200.

P. 64. Insert as the fourth line of description of Gymnostomum rupestre "deshiscent operculum. Very much less frequent than *G. cur-*"

P. 108. Read "Family 18" instead of "Family 8."

P. 157. Accent Lunularia as on p. 205.

P. 159. Accent Reboulia as on p. 205.

The accents are omitted from several of the generic names due to a change of type and an oversight in replacing the accents when the type was changed.

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A NUMBERED LIST OF THE MOSSES DESCRIBED IN THE PRECEDING PAGES SYSTEMATICALLY ARRANGED.*

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